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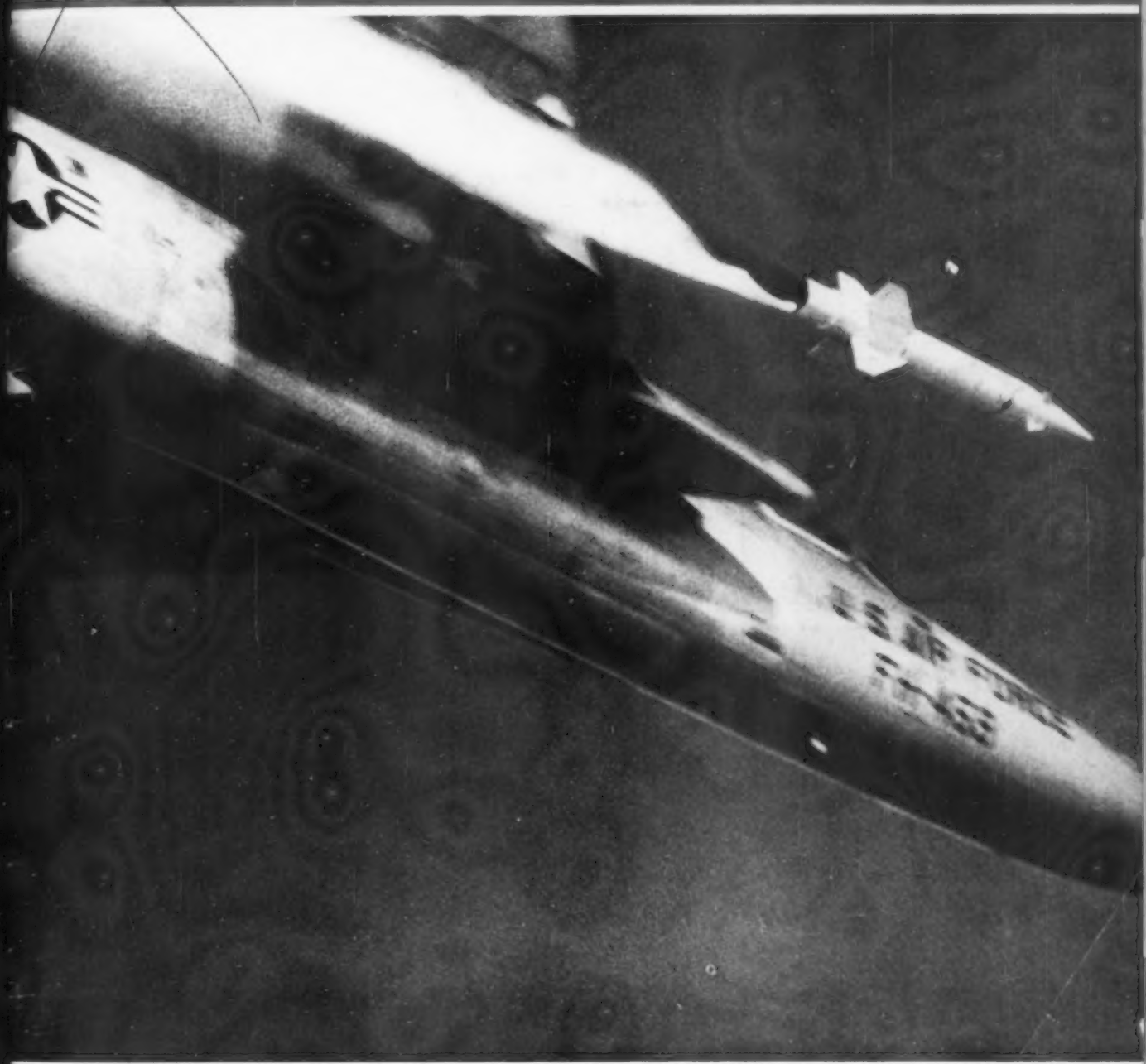
missiles and rockets

THE MISSILE/SPACE WEEKLY



Bullpup Limited-War Missile Fired by F-105

Will Congress Regulate 'Non-profits'?
Key Decisions at Hand in Moon Progra
U.S. Seeks Oceanographic Instruments . . .

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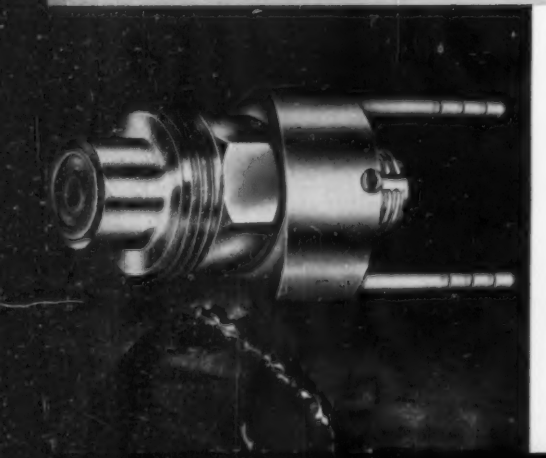

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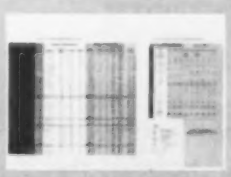

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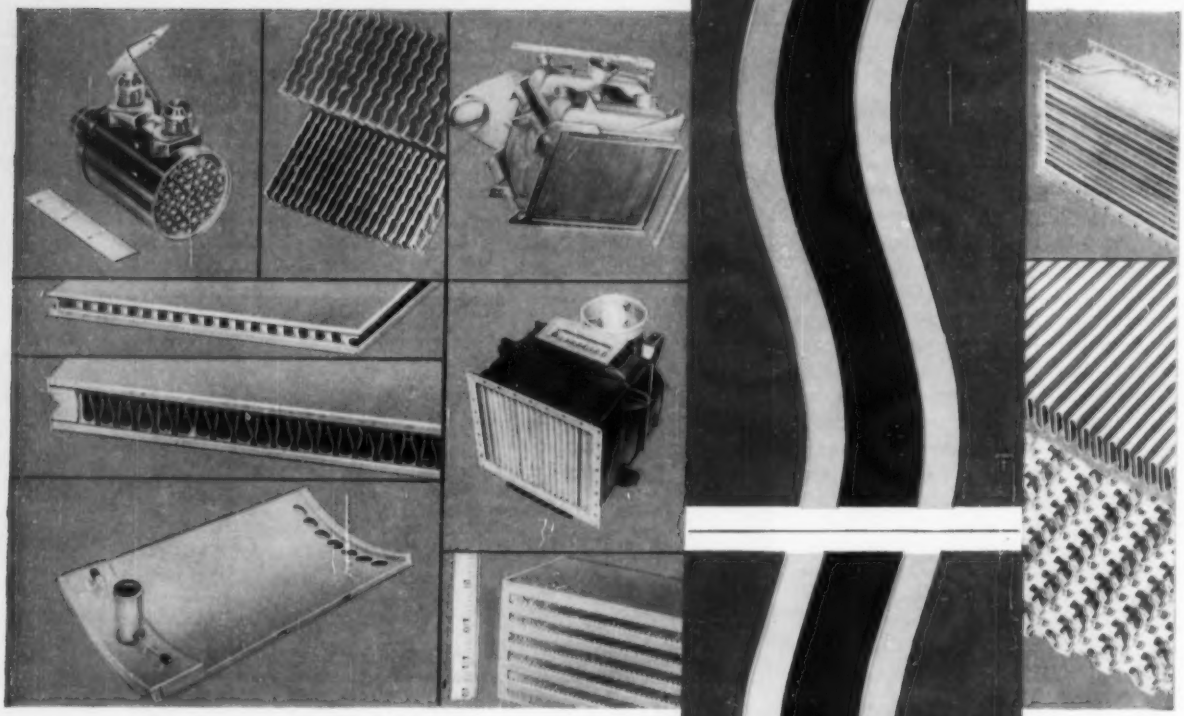

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THE MISSILE / SPACE WEEKLY

missiles and rockets

Volume 9, Number 9 August 28, 1961

THE COVER

Martin Bullpup air-to-surface missile is shown in newly released Defense Department photo an instant after launch from Air Force Republic F-105 tactical fighter.

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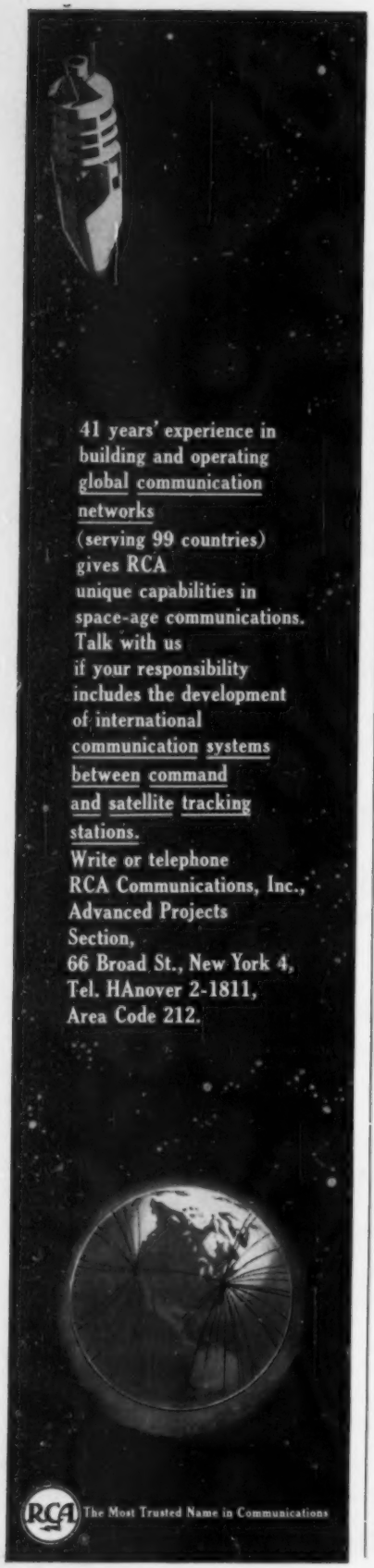

letters

Senator's Rebuttal

To the Editor:

After reading your Aug. 7 editorial ("America Still Wants to Know"), which you so kindly sent me, I am rather confused as to just what is your editorial mission. Are you proposing to further the interest of missiles and rockets, or are you proposing to defend the inaccuracies of the *New York Times?*

First of all, let me agree with you in that I didn't think the (television) program you referred to was startling, nor did I think we developed the material that could have been developed—but this is no place to discuss the additives to that particular program.

The bulk of your editorial concerns a story in the *Times* by Jack Raymond, which I still maintain was completely inaccurate. If you will carefully read the entire story by Mr. Raymond, you will note that he flatly credited (Gen.) LeMay with plans to appeal for the B-70, which up to that time LeMay had never asserted. He further made the statement that the Air Force "is preparing a vigorous appeal to Congress," which the Air Force had never indicated that it would.

Then, if you would go further into the story, you find the *Times* credited completely to the Air Force a statement released by the Pentagon on the Moscow Air Show. The Air Force up to that time had no comments concerning the July 9th Air Show. As a matter of fact, General LeMay's answers were practically identical to those of General Tommy White's in prior Congressional testimony and were not based upon the Moscow Air Show.

As to this being a "heated denunciation of the *Times*," I can't understand why one or two sentences out of hundreds during the course of an interrogation constitutes a "heated" discussion. I had made the denunciation on the Floor of the Senate two days before, and no one seemed to take any cognizance of it, which is normal with the liberal press of this section, but for you to spend an entire editorial on a case of irresponsible reporting, frankly, is beyond me.

The *New York Times* seems to be a little bit like some of the Scripture, "He dare not tread upon it." Inasmuch as you have asked for my rebuttal, I would say that if the title of your publication is MISSILES AND ROCKETS, I would stick to the subject. Don't spend your time defending inaccurate reporting by a publication that, as far as I know, is not related to yours, unless perchance it owns you.

Barry Goldwater
United States Senate

On 'Non-profits'

To the Editor:

I read Mr. Gene C. Burns' letter on nonprofit corporations (M/R, Aug. 7, p. 6) with great interest. Certainly, I don't pretend to speak for kindred organizations, but there are a few things that ought to be clarified from the point of view of The MITRE Corporation.

Mr. Burns accused MISSILES AND ROCKETS editors of supporting editorially the nonprofit corporations which provide technical advice to the military, because of space advertising placed with the periodical. Heaven help M/R if the dollars it receives from MITRE for technical recruitment "ads" are of major financial significance. Actually, trade publications derive the great majority of their advertising revenue from conventional profit-making and stock-issuing firms.

It is quite true that most of the "nonprofits" carry on public information activity. One of the most serious problems facing the world today is a basic limitation in the ability to communicate effectively. Narrow this problem to the United States and we find there is an acute communication problem in government and industry as a whole. Although no all-encompassing answers have been found, one solid step is a workable communications program for news media.

In truth, a non-stock, not-for-profit company is a much misunderstood business entity. Manufacturers invariably regard such firms with vague suspicion. Even arms of the government—and bear in mind The MITRE Corporation is chartered only to serve the government—have questions and doubts. They must learn that we do not compete with manufacturers, or even "in-government" organizations. Rather, we seek at all times to cooperate with them as an integral part of the government-industry team that, in MITRE's case, is facing up to the stern technical demands of electronic command and control work.

Occasionally, public information activity, particularly recruitment advertising, draws job inquiries from people, who for one or more reasons, do not qualify for posts with the involved organizations. When this happens, I submit it is regrettable, but hardly fraudulent.

As to disguising recruitment publicity effort in a "salary survey" budget, MITRE most assuredly does not. In fact, the firm has never conducted a formal salary survey. Should a survey be required, however, it would be handled openly and with no hidden purposes. Since MITRE does participate in certain national salary surveys, as a client, we seem to be in a position to observe any untoward actions on the part of other "nonprofits." There has been nothing that we could observe to rate the fuzzily worded letter of accusation from Mr. Burns.

MITRE has hired qualified technical personnel in a conservative but steady pattern since the nucleus of its Technical Staff —205 engineers and scientists—formed MITRE in January, 1959. At this writing our Technical Staff numbers some 450, backed up by an equal number of technical and semi-technical people as well as a conventional complement of administrative

(Continued on page 40)

more than the name is new

Fairchild Stratos Corporation* is a new name-but the new doesn't stop there. There is dynamic new leadership-new energy and enthusiasm-new programs and projects...and the creative technical skills to implement them.

Perhaps most significant are the exciting new career opportunities ahead for creative professionals in such fields as guided missiles, drone systems, space satellite equipment, precision mechanical equipment and sophisticated electronic systems. This is the new look of Fairchild Stratos. This is the plan for sound and vigorous growth for the immediate future and for the long term. Fairchild Stratos is on the go.

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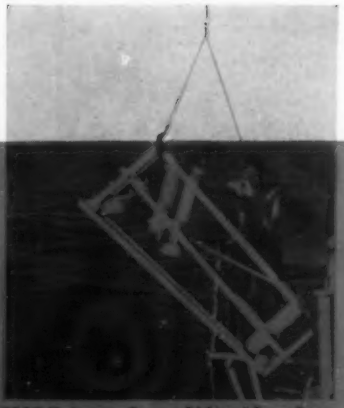
EXPLORING THE HIDDEN SURFACE OF THE WATER PLANET



EG&G Underwater Camera, Light and Sonar System

Fig. I 17th Century Diving Bell.

More than one hundred million square miles of Earth's surface are completely unknown to man. These are the super-continents that lie more than a thousand feet under the ocean, where sunlight has never penetrated.

A total of about one square mile of this unknown world has been photographed in various oceans by EG&G automatic underwater cameras. Positioned by EG&G sonar equipment and using EG&G flash equipment for illumination, these cameras have made excellent photographs at 27,500 feet below sea level where the pressure is more than seven tons per square inch.

EG&G is also deeply involved in control instrumentation for the first nuclear rocket engines (Project Rover), the international program for detection of nuclear explosions (Project Vela) and instrumentation systems for non-military applications of nuclear explosions (Project Plowshare).

An informative brochure which describes the breadth and depth of EG&G's capabilities is available on request.

For information about employment prospects with this unique, vigorous organization write in confidence to Lars-Erik Wiberg. All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

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The Countdown

WASHINGTON

Choosing the Game

Once again, the Kennedy Administration is staring at the problem of establishing an overall defense structure. It must decide very soon now on the general outlines of defense forces it wants to set out the guidelines on the FY '63 DOD budget. The key questions that must be answered by the White House: Will we really expand our strategic missile forces? Will we really equip a bigger limited war force, including a million-man Army? One tip-off to the way the wind is blowing could be a decision to go beyond the 29th *Polaris* sub. And that decision should be made this fall.

Readying Abraham Lincoln

The nuclear-powered Abraham Lincoln—fifth submarine of the *Polaris* fleet—is reported to be taking aboard combat missiles in preparation for deployment. The Abraham Lincoln is understood to have launched a half dozen *Polaris* missiles near Grand Bahama earlier this month. Score: Four successes; two partials.

Cape Silo for Titan II

The Air Force is expected to have at least one of two R&D silos ready for launching *Titan II's* from Cape Canaveral in October. The first launching of a *Titan II* is scheduled for November.

Brief Stop in Moonland

The first Americans who reach the moon are going to have to be quick on their feet. NASA requirements laid down for the *Apollo* program allow only four hours for lunar exploration on the first manned mission.

Dyna-Soar: A Speed Up?

The Defense Department is expected to make its decision shortly on whether to accelerate the *Dyna-Soar* program in line with the intent of Congress in passing the FY '62 defense money bill. Meantime, an official inspection of the *Dyna-Soar* system mockup is scheduled for next month. Some 11,000 to 18,000 hours of planned wind-tunnel tests have been completed in the current program.

Who's Confused?

NASA officials are considering changing the name of the *Saturn C-3*. They feel the *C-3* designation is confusing because the *C-3* has at least two F-1 engines while the *C-1* has eight H-1 engines, thereby being quite different. And then there are all those *S* stages on the *C-3*, some of which aren't there anymore and what with the scratching of the *C-2* which wasn't much like the *C-3* either, it's really a mess.

INDUSTRY

Titan Man-hours Slashed

The Martin Co. has cut by more than two-thirds the man-hours expended in the production of a *Titan I*. The man-hour rate for early missiles was 75,000; now, halfway through the production run, the rate is 19,000. The man-hour rate for the first five *Titan II's* has averaged 35,000.

RAC Contract Due Soon

The Army is expected to sign a contract soon with its new "non-profit" company—Research Analysis Corp. The new "think factory"—successor to Johns Hopkins' ORO—is expected to take over most of the ORO personnel and occupy ORO's old headquarters near Washington. The initial contract for FY '62 is expected to run between $4 million and $5 million.

New Product Names Dept.

The U.S. Air Force, that great coiner of Space Age nomenclature, is now distinguishing between equipment and such cloudier products as system studies by the names: "hardware" and "software."

R&D Intelligence

NASA is recommending a 6-segment solid *Nova* engine (see p. 14) to the joint DOD-NASA space booster committee. . . . A solar flare observatory is being set up in Antarctica by the National Science Foundation and Douglas Aircraft. It will start operations in December. . . . Kaiser Industries reports a 1961 first half loss of $3.4 million from joint ventures in the construction of ICBM bases. . . . Russian astronomers are saying the moon would be a wonderful place to set up a telescope—no mention of missiles.

INTERNATIONAL

West German Big Missile Punch

West Germany by 1963 will have a major stockpile of missiles capable of launching nuclear warheads. Each of the West German Army's 12 divisions is expected to have a battalion of *Honest Johns;* each corps a battalion of *Sergeants*. The West Germans also will have a sizeable force of *Pershings* and air-breathing *Matadors*.

French Mail by Rocket

CNET is reported to have tested some new nose cones in recent launchings of mail rockets in the Sahara. CNET is cooperating with Latecoere in the R&D postal rocket project. The nose cones were made for new Sud Aviation *Belier* and *Centaure* rockets.

Overseas Pipeline

The Czech Army is showing off a new Czech-made antitank missile. . . . The French nuclear test site at Reggane in North Africa is to be used as an impact zone for missile warhead tests. . . . The West Germans are talking about establishing a Federal Agency for Space Research.

GENERAL METALS ACQUIRES AIRCRAFT PRODUCTS BUSINESS

General Metals Corporation, Industrial subsidiary of Transamerica Corporation, announced today that it had acquired the Aircraft products business of Gladden Products Corporation, Glendale, Calif.

William E. Butts, General Metals' President, said the acquisition includes lines of hydraulic and pneumatic components for aircraft and missile, the production of which will be continued from the General Metals Adel Division Plant at Burbank, California. Technical and production personnel engaged in their manufacture at Glendale will continue that activity for General Metals at the Adel Plant.

The other subsidiary companies of Gladden were not included in this transaction, Mr. Butts said.

Adel Division of General Metals specializes in the design and manufacture of hydraulic, pneumatic, fuel and electro-mechanical systems and power generating packages for aircraft, missiles, rockets and ground support applications. Butts said the combined operation will continue to specialize in these fields, offering products which have been developed through the experience of each company during many years.

During the past eighteen months, General Metals has completed the enlargement of its facilities in Houston, Texas and in the San Francisco Bay Area has integrated the Enterprise Division with its iron and steel facilities in Oakland. The Company's Enterprise Diesel Engine Division at Oakland produces Diesel Engines for stationary power plant and Marine application.

The Missile/Space Week

Ranger Backup Shot Set for October

NASA is planning a second *Ranger* launch in October—backup to *Ranger I* which failed Aug. 23 to go into its planned 37,500/685,000-mi. orbit.

Ranger I wound up in a 105/312-mi. earth orbit when its *Agena B* stage failed to restart as programed.

Although the flight was at first believed to be almost a complete failure, NASA officials said later the lunar spacecraft's attitude stabilization system was working perfectly. It was locking onto the sun properly and when it passed into the earth's shadow its nitrogen jets fired in a vain attempt to find the sun again.

The earth orbit, however, precluded proper functioning of the experiments aboard, which were designed to measure magnetic fields, energetic particles and their interaction in deep space. *Ranger I* was in a 91-min. orbit with an inclination of 33°.

NASA Hunts for Apollo HQ

A four-man team from NASA last week surveyed possible sites for the $60-million manned space flight center which will direct Project *Apollo*.

The team visited Tampa and Jacksonville, Fla., Shreveport and the central Louisiana area and Houston, Tex.

NASA officials said that other areas will be inspected, but that the team's future schedule has not been worked out.

Sixty million dollars for the new center was included in the space agency's Fiscal 1962 budget. Officials said that the site should be picked and construction work begun by the end of this year.

The center, to have 1600 employees, will be the focal point for training *Apollo* astronauts and will handle development of the spacecraft.

The NASA survey team is headed by John Parsons, deputy director of Ames Research center.

The criteria for the selection of the site includes: accessibility to water transportation, modern communications, skilled labor market, industrial complex, proximity to higher education, a land area of 1000 usable acres, and availability of interim facilities.

MA-4 Postponed Twice

The scheduled launch of the *MA-4* unmanned *Mercury* capsule (above) into earth orbit was postponed twice last week because of technical difficulties in the spacecraft.

The shot was rescheduled for Friday, Aug. 25, but space agency officials said it might be delayed until this week.

NASA officials did not divulge what specific problems forced the postponements.

Saturn Altimeter Award

NASA has awarded Ryan Electronics a contract for development and fabrication of a high-altitude radar altimeter for the *Saturn* booster.

The $450,000 contract with the San Diego, Calif., firm is to be completed within 14 months.

More Titov Data

The Soviet newspaper *Pravda* said that a large number of tracking stations were used to monitor Gherman Titov's 17½-orbit spaceflight.

The paper said ships in both the

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Atlantic and Pacific were used and all calculations were carried out at several different points simultaneously by electronic computers.

It indicated that the capsule had been equipped so that Titov could have landed safely and survived in water or uninhabited locale.

Pravda also said at least two possibilities would have forced premature completion of the flight; a sudden increase in sun radiation or illness or distress affecting Titov.

The paper also published photographs of Titov, transmitted to earth by TV. Five of the pictures were taken by a camera with a narrow-angle lens, centered on Titov's face, and two by a wide-angle lens, with a view of his body and part of the chamber.

Work Stoppage Bill

A bill has been introduced in the Senate aimed at ending unauthorized work stoppages at missile bases.

Under the bill, employees who took part in walkouts, slowdowns or other concerted work stoppages not authorized by their union could be fired.

The measure was sponsored by Sen. Carl Curtis, with Sens. John L. McClellan and Karl Mundt. McClellan is chairman, and Curtis and Mundt members, of a special committee that recently held hearings on the problem.

No More MR Flights

The space agency announced last week that there will be no more manned suborbital flights down the Atlantic Missile Range.

The NASA announcement said that Project *Mercury* officials will now devote themselves to getting a U.S. astronaut into orbit late this year or early next year. (M/R, July 31, p. 16).

The agency said that all expected results of the suborbital series had been achieved and no further flights would be necessary.

It added that all seven U.S. astronauts would be considered for Project *Mercury's* first manned orbit shot.

The manned suborbital series chalked up two successful flights, one by Astronaut Alan Shepard last May 5 and another by Virgil Grissom on July 21.

Explorer Loud and Clear

NASA officials say the *Explorer XII* satellite is sending more information back to earth than any other satellite launched.

This stems from the satellite's highly elliptical orbit which permits it to be in contact with ground stations for far longer periods than other orbiting spacecraft.

The satellite—launched August 15—is designed to study the Van Allen radiation belts and energetic particles in space. Officials said it would be about two weeks before data on the radiation belts can be analyzed.

Orbiting period of the satellite is 26½ hours. Its apogee is 47,800 miles, its perigee, 180 miles; and its inclination is 33.3 degrees.

Officials estimated its life at one year, at least. Three similar satellites will be launched over the next 2½ years.

Shots of the Week

• A *Polaris* was destroyed 33 seconds after launch when it veered off course after being fired from the U.S.S. Observation Island. It was the third straight failure of the advanced *A2* in a shipboard launching after three successes.

• The Army's *Pershing* had its 17th successful launching as Army Secretary Elvis Stahr looked on.

• A SAC crew successfully launched an *Atlas* from Vandenberg AFB. The Air Force said the 576th missile squadron "fully demonstrated" their proficiency.

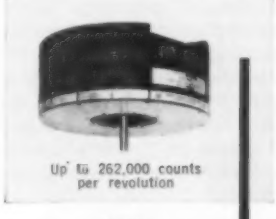
New Nortronics V.P. Named

The Northrop Corp. has appointed William F. Ballhaus executive vice president, and named Frederick Stevens vice president and general manager of its Nortronics Div., succeeding Ballhaus.

Stevens has been vice president and manager of Nortronic's Electronic Systems and Equipment Dept.

Ballhaus, a vice president of Northrop and general manager of its Nortronics Div. since August, 1957, joined the company in 1953.

Both men are graduates of Cal Tech.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BROOKS *of House.*

Concern is growing...

Will Congress Regulate N

Influential members are asking whether DOD's annual $325-million investment in such firms really cuts costs

ALTHOUGH NOT outwardly apparent, congressional concern over the expanding role of non-profit corporations in government research and development programs is continuing to mount.

The outlook: Public hearings later this fall or early next year and congressional recommendations for some form of federal regulation.

The principal congressional committee currently digging into the operations of the "non-profits" is the House Committee on Science and Astronautics, headed by Rep. Overton Brooks (D-La.). Several other important committees—particularly the powerful House Defense Appropriations Subcommittee—are keenly interested.

Meantime, the Bureau of the Budget is proceeding with its own study of the "non-profits" in line with a directive issued earlier this month by President Kennedy. The study is due before Dec. 1.

Congressional hearings on "non-profits" had been expected late this summer. However, preoccupation with the Berlin crisis, the increased space program and other matters forced Congress temporarily to put the "non-profits" question aside.

The Administration's inquiry could bring about a further postponement until the inquiry is completed. There is some feeling in Congress that this is one of the major reasons why the inquiry was ordered.

The President's directive to David Bell, Budget Bureau director, said that he should specifically look into:

—"The effect of the use of contractors on direct federal operations, the federal personnel system, and the government's own capabilities, including the capability to review contractor operations and carry on scientific and technical work in areas where the contract device has not been used, and policies and actions needed to increase the government's capabilities in these respects."

—"The policies, if any, that the government should follow in controlling the salaries and fringe benefits of personnel working under a contract and the appointment of management and dismissal of such personnel . . ."

In general, the President said: "I would like to have full consideration given to the limitations which make direct federal operations difficult and to the development of proposals for adjustments and new concepts in direct federal operations which would provide the government with greater flexibility in determining whether the public interest would best be served by the use of contractor or direct government operations."

• **Burning questions**—Through the foggy sentences, the President raised two of the main questions that are being increasingly asked by congressmen: What effect is the salary structure of the "non-profits" having on industry and the Civil Service? Is the public interest being served in accomplishing tasks more competently at reduced cost?

The directive appeared to pass over several other equally significant questions that are being raised on Capitol Hill.

One of these is whether the "non-profits" could be or are being used for the dissemination of proprietary information among defense contractors. Another is whether "non-profits" could be or are being used to "wire in" subcontracts for contractors.

• **The investment**—The total value of all Defense Department contracts to non-profit corporations and institutions of various types is running today at about $325 million a year.

This figure includes everything from contracts with universities—where the contract is incidental to the institution's primary operations—to companies such as Aerospace Corp. which were created solely to handle government assignments.

Further refinement of this figure is made difficult by the many gray areas involved. However, some fairly firm figures are available.

The bulk of the non-profit contracts are awarded by the Air Force. In FY '62, the Air Force expects to award a total of about $198 million in contracts to non-profit companies and organizations.

More than half of this—$107.9 million—will go to six contractors: RAND, ANSER, Lincoln Laboratory, MITRE, STL and Aerospace.

The Army and Navy combined are expected to award at least some $30 million to non-profit companies and organizations.

However, these figures for the three services do not include many of the university research contracts or contracts let by ARPA or the Office of the Secretary of Defense.

Another way to get at how much of the defense budget is going to non-profit companies is by separating the contracts that are awarded to so-called "captive" organizations and those organizations that handle federal projects as only part of their total activities.

The total value of all defense contracts going to the former are now running at about $153 million a year. Of this, about $35 million is going for operations research—the "think factory" group.

• **Really necessary?**—Critics of the "non-profits" contend that most of these contracts are unnecessary; that the same job could be done cheaper and better

Non-profits'?

by James Baar

I. GETTING
Aerospace President.

C. W. HALLIGAN
MITRE president.

F. R. COLLBOHM
RAND president.

by the services themselves and by private industry.

The services and the Defense Department contend that they could not; that truly objective studies and advice can not be obtained from hardware manufacturers and that a sufficient number of technically qualified people cannot be retained within the salary structure of the government.

Critics contend that the "non-profits" have hired technically qualified staffs by raiding industry and the government—and thereby driving up the salary scale in industry.

The "non-profits" and the services contend that the "non-profit" organizations' salary scales are based on the going rates in private industry; that only a relative few people have transferred from the government to the "non-profits;" and that in many cases men have switched from industry to the "non-profit" companies at great financial loss.

Critics contend that the operations of the "non-profits," far from costing less than they would if performed by private industry, actually cost more. This contention is based on a charge that because the captive companies are "non-profit," their costs are not suspect and, therefore, tend to be excessive.

The "non-profits" and services insist that all costs are closely watched. However, some tentative studies show that costs by "non-profits" are seldom disallowed.

• **Chief target** — Unquestionably, the "non-profit" company under the greatest fire in recent months has been Aerospace Corp., the Air Force's successor to STL, and principal technical adviser on missile and space R&D programs. It has a staff of more than 2600 employees. Plans call for nearly doubling the staff in the next 18 months.

The Air Force requested $35.2 million for Aerospace Corp. for FY '62 in the budget submitted to Congress. During FY '61, Aerospace received $26.4 million, covering its initial organization period.

The House Defense Appropriation Subcommittee slashed $5 million from the Air Force request and bitingly said in reporting out the defense money bill:

"The Committee feels that the salaries paid by the Aerospace Corp. are excessive; that its overhead costs are too high and that it plans to employ too large a staff. The Air Force should either be able to obtain its required services from Aerospace Corp. for $30.2 million or find another method of coping with the problems involved."

The Defense Department accepted the cut in soothing tones and Congress sustained it on the floor.

Nothing since then appears to have changed the attitude of Congress toward the "non-profits." ⠿

	FY '62 (Millions)
RAND	$ 11.6
ANSER	1.0
LINCOLN LAB	15.3
MITRE	15.0
STL	34.8
AEROSPACE	30.2
OTHER	about 90*
TOTAL	197.9

*Divided among approximately 240 non-profit contractors.

AIR FORCE BUDGET *for "non-profits" is almost ⅕ of total $325 million spent by Pentagon in Fiscal Year 1962.*

Salaries	Aerospace	APL	Assoc. Univ.	IDA	MITRE	RAND	Lincoln Lab
$75,000	1						
50,000-75,000	1					1	
35,000-45,000						2	1
27,500-45,000	4				1		
30,000-40,000				5	2		1
20,000-33,000	13						7
25,000-30,000		1	2	9		2	
22,500-30,000					6		
21,000-28,000	5						
22,000-26,500							6
20,000-25,000	9	13	12	26			
Total above $20,000	33	14	14	40	9	5	15

SALARY SCALES OFFERED *by "non-profits" constitute a principal target of congressional criticism. These figures, based on official studies, show the number of persons in various salary brackets at some "non-profit" firms.*

Will liquid Nova slip? . . .

Big Moon Booster Decisions Looming

NASA prepares to pick lunar launch site, release specs for Nova-type solid, study liquid Nova proposals

by Hal Taylor

SPACE OFFICIALS are edging closer to three key decisions affecting big booster systems for the U.S. lunar program.

• Within the next 30 days NASA is expected to designate a launch site for moon vehicles. First choice is Cape Canaveral; the east coast of Georgia is second.

• Wraps will be taken off the specifications for the *Nova*-type solid booster at a bidders conference in late October or early November.

• Design studies for the F-1 engine-powered liquid *Nova* vehicle are due to be submitted to NASA in September. The studies were made by North American, Lockheed Aircraft Corp. and General Dynamics/Astronautics. NASA hopes to award the hardware design contract by the end of the year.

This timetable is threatening to build some slippage into the liquid *Nova* development. The F-1 engine was fired Aug. 16 for the 19th time at thrust levels over 1 million lbs.—indicating it is meeting its schedule for on-time delivery in early 1963. There are estimates that it may take 24 to 30 months to produce the vehicle, which would push back the first flight tests into 1964—a year after the F-1 is ready.

Some officials are indicating, however, that the F-1 may be put to work in the *Saturn C-3* in 1963, which would take up the slack.

• **Site survey**—A NASA survey team conducted its last tour of proposed launch sites for the *Nova* vehicle last week. Besides Cape Canaveral and the Georgia coast, other areas considered seriously were the coast of Texas and White Sands Proving Grounds, N.M.

White Sands was ruled out because there is no water access to it. The Texas site lost favor because launchings from it would fly over inhabited land masses.

The survey team's final recommendations are expected to be in the hands of NASA administrator James Webb sometime this week. Most NASA officials favor Cape Canaveral because of its existing tracking and ground facilities. On the other hand the Georgia site would prevent overcrowding Canaveral's launch facilities while still permitting use of the Atlantic Missile Range tracking system.

Whichever site is selected, NASA officials expect to spend from $25 million to $50 million on land acquisition.

While the question of whether one launch site can be used for both the solid and liquid versions of *Nova* has not been resolved, the setting of a date for a bidders conference on the solid engine awaits only a decision as to its specifications by a joint NASA-DOD committee on launch vehicles.

It had been hoped that the conference could be held in October, but the decision of the committee—expected in about seven weeks—may delay it for a short while.

• **Segmented solid**—NASA has recommended the committee approval of the following specifications for the solid first stage:

• Eight clustered engines with a thrust of 2.5 million lbs. each for a total first-stage thrust of 20 million lbs. Each engine would have six segments.

• The stage would have an overall length of 120 ft. and each engine a diameter of 160 inches. Total diameter of the stage would be 45 ft.

• Gross weight of each engine would be 1.3 million lbs., for a total weight of 10.1 million lbs. Each segment would weigh 231,000 lbs. Total weight of the four-stage vehicle would be 12.2 million lbs.

• It would be able to boost a payload of 170,000 lbs. to escape velocity.

• Stage burning time would be 100 seconds.

Certain space officials have called for a wider diameter for each engine with a resulting cut in the number of engines in the stage. This is being studied by the committee.

Development of the solid version of *Nova* would have gone a lot faster if more money had been made available. For instance, there is a decided lack of money for such things as designing the stage, studying the question of the interaction of the solid stage with the rest of the vehicle and the development of a guidance system. As a result, much of this work will be put off until money is obtained in Fiscal 1963 appropriation bills.

The space agency has not yet released much information concerning the specifications for the liquid version of *Nova*. This apparently is because the three design studies have not been completed and no decision has been forthcoming from the joint agency launch vehicle committee.

Reportedly, it is quite possible that

A New Medium Booster?

NASA IS entertaining the possibility of building an entirely new medium-thrust space booster to replace Thor *and* Atlas.

First step in this direction was the award of a six-month contract to Space Technology Laboratories Inc. last week to study the payload capabilities of existing medium-class vehicles with respect to future satellite and space probe requirements.

It is understood the study was motivated by a belief within NASA that it might be cheaper to develop an entirely new vehicle than to continue using Thor Agena B *and* Atlas Agena B.

Thors *and* Atlases, *depending how they are modified, are reported to cost NASA anywhere from $4-6 million apiece. This does not include developmental costs, which were paid largely in their R&D as missiles.*

To get under $4 million and amortize R&D as well, any proposed new space booster would probably have to be either solid- or storable liquid-fueled. It also would have to be planned for an extremely long production run.

Other factors which influenced the NASA study apparently are growing problems with mating spacecraft to Thor *and* Atlas *and a conviction that a rocket designed from the "ground up" as a space booster would be more reliable.*

NASA will first award a design contract for the stage before the end of the year and then award a contract for its production later.

The liquid-powered F-1 engine will have a thrust of 1.5 million lbs. How many engines will make up the first stage still has not been decided.

Dimensions of the liquid version are expected to approximate a total height of 340 ft. The first stage will be about 45 ft. in diameter, second stage 35 ft. and third stage about 27 ft.

Present plans call for test-flying both liquid and solid versions before reaching a final decision as to which will be used to boost the *Apollo* spacecraft to the moon.

• **F-1 for Saturn C-3**—Information turned up by MISSILES AND ROCKETS' West Coast Bureau indicates that NASA is expecting to move quickly on the *Saturn C-3*, which is to be powered by two F-1 engines.

Erich Neubert, the Marshall Space Flight Center's associate director for R&D, says while the *C-3* will not have the *Saturn C-1* eight-tank booster configuration, it would be designed for almost the same burning time. This indicates greatly increased tankage and, therefore, external size—spelling a requirement for new or drastically modified ground launch facilities.

Neubert maintains that the F-1 will not sit in a warehouse for any substantial period after delivery. The *C-3*, it is claimed, can be ready for mating with the F-1 when the engine is delivered, presuming the go-ahead is given by the expected date of January 1. This means that NASA must firm the *C-3* design, modify tooling, begin metal work, test the structure in many ways, and have the vehicle ready for test—all within the twelve months available before the F-1 delivery.

The *Nova* vehicle itself, Neubert said, would take about 24 to 30 months to design and build, if past vehicle-design experience holds true. There was no explanation why *Nova* would take at least two years, and the "completely new" *C-3* could be ready in one year.

Apparently referring to Soviet success with *Vostok II*, Neubert said: "No event will push development of F-1 or *Nova* at the sacrifice of reliability".

Some observers see a possibility—albeit remote—that future developments in solids might conceivably leave the F-1 engine in the same situation as Rocketdyne's E-1, which was begun as a research engine to see if rockets of half a million lbs. thrust were feasible.

As the E-1 proved the feasibility, there was some slight effort made to design a vehicle to take advantage of then-existing hardware and tooling. However, no vehicle was designed and the E-1 died without ever flying. ⌗

WESCON Speaker for Active ComSats in Stationary Orbits

by Charles D. LaFond

SAN FRANCISCO—Stationary-orbit active satellites must become the backbone of future global telecommunications.

Excluding special military requirements, passive satellite communication systems will never be economically competitive with high-capacity active satellites.

These findings were presented here last week before a technical session of the 1961 Annual Western Electronic Show and Convention (WESCON) at the Cow Palace.

S. G. Lutz of Hughes Research Laboratories, Malibu, Calif., supported his argument with a list of 12 significant advantages—seven economic and five technical—for the stationary-orbit active system. He conceded that there are space-technology and propagation-delay problems to be overcome; and he emphasized the need for more planning and regulation of the stationary satellite communication systems.

Lutz stressed that his study concentrated on commercial, high-volume, common-carrier satellite systems and on their governmental point-to-point counterparts. Further, he assumed the ultimate goal of achieving the most communications per system dollar spent.

• **Components galore** — The continuing hold of small-components exhibitors in the great Cow Palace was never more evident. There was only a sprinkling of system-type displays—these being a few missile systems, space chambers, and major computer and guidance subsystems.

The available 1170 booths were filled to capacity by more than 800 exhibitors.

Attendance during the four-day meeting was expected to exceed 36,000.

To heighten interest throughout the 42 technical sessions, panels provided enlightened critiques of each paper. In general, three papers were delivered in each session, for a total of over 120 topics.

By M/R's press time, considerable interest had been generated by a special "Arms Control" discussion. The two-hour night session was scheduled to provide five nationally known authorities covering each critical area of the subject: technical, military, politico-economic, psychological problems, and nuclear consideration.

Dr. L. C. Van Atta, former special assistant for arms control to the Director of Defense Research and Engineering, was to chair the panel. Other panelists included Dr. W. H. K. Panofsky, Stanford University; Rear Adm. P. L. Dudley, Joint Chiefs of Staff; Harry Rowen, DOD; Dr. D. G. Brennan, MIT's Lincoln Laboratory; and Dr. C. E. Osgood, University of Illinois.

• **Satellite communications** — Lutz eliminated military communication satellites from his argument for several reasons:

—The *Courier*-type low-orbit memory satellite offers military security advantages that far outweigh commercial limitations.

—*Echo*-type passive systems are virtually non-jammable.

—The Project *Needles* (orbital chaff) approach appear virtually indestructible.

—Active non-stationary systems employing high power densities or the equivalent in correlation coding offer advantages for communication with vehicles (but at a sacrifice in data capacity and frequency-sharing ability).

—Finally, he said, while commercial systems evolution can be predicted with a reasonable accuracy, new military requirements or new techniques for satisfying military requirements could at any time invalidate predictions of ultimate military systems.

• **Passive systems countered**—Lutz believes the immunity of passive satellites to electronic failure is an advantage easily overemphasized.

Active systems, he asserted, can be competitive with present transoceanic cables even if satellites are replaced on an average of once a year.

Further, he said that Bell Telephone Labs is now designing a satellite-travelling wave tube which will have an 18-year life expectancy. Submarine cable repeaters have already shown similar operating life without tube failure.

The problem with passive satellites —as with non-repeater submarine cable in the past—is the intolerable system cost per circuit.

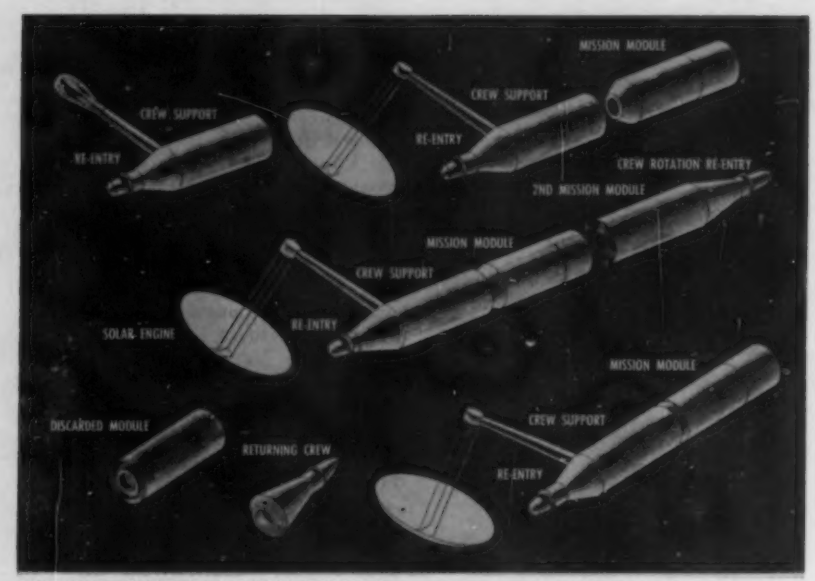
While it is true, he said, that passive satellites offer higher capacity per dollar in orbit, the real cost is reflected in the shift of electronic burden to ground terminals and resultant higher total cost. ⌗

Correction

Roy P. Jackson of Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif., who heads the company's Saturn project team, was incorrectly identified as Johnson in last week's COUNTDOWN.

Available by '63 . . .

DEIMOS Manned System Is Described



MARTIN ARTIST'S CONCEPTION shows sequence of DEIMOS system from rendezvous and closing of first crew and mission module (top) through crew replacement.

DENVER—Details of Project *DEIMOS*, a manned space logistics system which could be operational by 1963, have been disclosed here by Martin-Denver.

The system has been proposed to the Air Force as an interim step to such systems as *MTSS (Manned Test Space Station)*, *SLOMAR (Space Logistics, Maintenance and Repair)* and *SMART (Space Maintenance Repair and Techniques)*. Company sources report initial Air Force reaction as favorable, and a detailed technical report now is being drawn up for presentation to the Air Force and Department of Defense late this year.

Sundstrand Aviation and Hughes Aircraft are working actively with The Martin Co. on the proposal. Since the project calls for use of a scaled-up two-man *Mercury* capsule, Martin also has discussed it with McDonnell Aircraft.

DEIMOS is a company acronym for Development and Investigation of a Military Orbital System. It also is the name of the second moon of Mars.

• **Railroad style**—As described by Dr. Carl Kober, director of advanced technology at Martin-Denver, *DEIMOS* is an effort to standardize a space logistics system on a "railroad" concept. It would employ standard "freight cars" and "passenger cars" with standard couplings to carry varying payloads into orbit. Once there, they could be assembled into what might be called a space train.

Booster for the system would be a modified two-stage *Titan II*.

"Since this is not an ambitious program, we could begin flying in the middle of 1963, employing a two-man *Mercury* capsule," Dr. Kober asserts. To achieve this date, hardware development would have to begin this year.

With modification, *Titan II* is believed to be capable of putting into 300-mile orbit a capsule of approximately 10,000 lbs. This would be unit weight of the passenger and freight sections.

Astronauts could be shuttled back and forth to the space train when desirable.

"The technology is ripe and mature enough to do this," Dr. Kober says. A big advantage of the system, Dr. Kober points out, is that no need exists for new hardware—both *Titan II* and the *Mercury* capsule are available.

• **Making connections** — Coupling in space offers the major problem to be solved in the system. First requirement in this is accurate rendezvous. Dr. Kober dismisses the rendezvous problem as over-stated.

"It is easier to do than aerial refueling," he asserts.

A tougher problem is that of sealing against a vacuum so that the crew of the space train can move freely from one module to another. The requirement also calls for the ability to break the seal and re-use it in space when necessary.

Now in the preliminary design phase, the seal interestingly enough is based on the same general principle as a railroad coupling pressure hose.

Rendezvous problems of the system are being worked out at Hughes Aircraft. Sundstrand is working on a solar-drive turbo-generator for the system.

The solar concentrator would be extended on the end of a long arm. Its deployment technique calls for inflation of a balloon, rigidization by foam injection, and burnoff of the balloon.

The resulting aluminized Mylar reflector would have a parabolic surface of revolution with a 60-deg. rim angle. Deployment time is estimated at 23 min.

The system is designed to supply 5 kw continuously for at least one year, at an 0.95 reliability factor. Its weight is estimated at 465.8 lbs.

• **Salt for storage**—Details of the power system released by Sundstrand show the unit employing a heat exchanger designed to minimize solar re-radiation from the cavity mouth while transferring solar heat efficiently to both lithium hydride and sodium fluoride for subsequent transfer to the working fluid (rubidium).

Sundstrand says the molten salts serve to store sufficient thermal energy to continue boiling and superheating the rubidium during transit through the earth's shadow.

The four-stage axial flow turbine directly drives an electromagnetic alternator and coolant/condensate pump at 24,000 rpm. A circular plate condenser is used in recovery, with the condensed liquid separated from the vapor by the centrifugally created gravity. It is recovered by coolant-powered jet induction pumps at the rim, then returned to the coolant/condensate pump.

Sundstrand has developed the powerplant under an Air Force Systems Command contract aimed at proving out feasibility of solar power units of up to 15 kw. ¤

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Technical Countdown

ELECTRONICS

Light Overtones Obtained from Laser

Using a Laser beam which produces a power density of 100 million watts per square centimeter at the focus, four University of Michigan scientists have—for the first time—produced an overtone of a beam of light. The experiment produced the second harmonic (or overtone) of red light by focusing the Laser's intense beam of red light into a quartz crystal. As a result of the extremely high intensity of the red light at this focus, the blue light was produced in the crystal in much the same way overtones are produced in music.

Sensitive IR Device Being Built for Navy

An infrared detector—so sensitive that it felt fractional changes in the moon's surface temperature during an eclipse—is being built for the Navy by Hughes Aircraft Co. At the heart of the device is a miniature refrigerating device which keeps the IR detector at its operational temperature of −452°F. The refrigeration unit—a closed cycle liquid helium cryostat—employs a Claude-type thermodynamic cycle to cool the helium refrigerant gas to a temperature at which Joule-Kalvin cooling may be used.

Photo Tachometers Measure Missile Model Spin

The Naval Ordnance Laboratory has developed several phototransistor tachometers to accurately measure the spin rate and decay rate of spin of missile models revolving as slow as two rps. in a supersonic wind tunnel. Consisting of a light source, a phototransistor and a perforated wheel or some other means of interrupting the light beam shining between the first two components, the tachometer's phototransistor senses the series of light pulses passing through the perforated wheel and changes its resistance accordingly. This yields a series of electrical signals which are counted per unit of time to determine the model's spin rate.

Testing of Gyro Torsion Rods Improved

An extremely sensitive system of calibrating gyro torsion rods—up to 37 times as accurate as the method previously employed—has been developed by Western Electric. The rod is inserted into the center detail of an inertia disk and turned 180 degrees. Suspended on a holding fixture, the disk is locked into position. When it is manually deflected to cause the rod to oscillate about the vertical axis, the reflected light from the oscillating disk activates an electronic counter which displays the ten-period average of the torsion rod and inertial disk. If this average falls into the proper range, the rod is passed on to the gyro assemblies.

OPTICS

Optical Tooling Improves Machining Tolerances

A high-precision optical tool for checking angularity and alignment of machine tools has been developed by the Michigan Tool Co. In effect a 360-sided optical polygon, the multipurpose tool can optically check for alignment and angular spacing in any multiple of full degrees. Working on the principle of autocollimation, the optical system measures the amount of deviation between the reflected image and the graduated crosshairs in the sighting device and gives a geometric check on misalignment, parallelism, angularity, etc.

ADVANCED MATERIALS

Cesium Market Growing

The increasing use of cesium in propellants will hit its highest point in 1963, when *Centaur* series tests are initiated. Chemalloy Minerals, Ltd., disclosed that each engine uses about 1000 lbs. of the element and the Mars shot scheduled that year with an ion engine will use about 2000 lbs. The firms has over 300,000 tons of pollucite ore in reserve at Bernic Lake in Manitoba. Assays indicate a 25% extractable cesium content.

Beryllium Sheet Development Extended

An Air Force cost-sharing contract totaling $255,000 has been awarded to Brush Beryllium Co. to continue the development of production techniques for aircraft-quality beryllium sheet. Surface finish will be emphasized. Fifty sheets, measuring 48 by 18 in., will be produced in the final production phase of the contract.

Space Effects Studied

The effects of extended space mission on non-metallic materials will be investigated by the Martin Co. under a $52,000 NASA contract. The main characteristics simulated will be vacuum and radiation. Loss in weight, evaporating molecular types and changes in strength will be checked.

Coated Fibers Studied for Satellites

Fabrics normally found in window curtains are being studied for the AF Systems Command for possible use in expandable, rigid satellites such as communications spacecraft or solar collectors. The study—being conducted by Westinghouse—is concentrating on fiberglass yarns, because of their temperature resistance and dimensional stability. A serious drawback to glass fibers—and one that will get the closest scrutiny—is the tendency for the fabric to wear out when it rubs against itself or against some other surface.

Temco's 'Shear-forming' Wins Army Contract

A sophisticated metalworking process called "shear-forming" was the principal reason behind the award of an Army contract to Temco Electronics, a subsidiary of Ling-Temco. Awarded to the company for the production of afterbodies for the *Davy Crockett*, the pact was based on demonstrated proficiency. "Shear-forming" changes a flat metal square into a cone in minutes by mounting the metal square on a shaft and rotating it under force from one side until the square gradually closes over a shaft-mounted male member. The resulting cone is uniform and seamless.

ASW & SEABORNE SYSTEMS

Underwater "Jeep" Acquired by Loral

With the addition of Dr. Dimitri Rebikoff to its staff, Loral Electronics Corp. has acquired rights to the T-14—an underwater vehicle which is termed the "jeep of the deep." Fabricated of corrosion-proof, lightweight aluminum and equipped with a control system enabling it to dive, loop, climb, and roll under water, the craft is only 9½ ft. long, less than a foot wide, and weighs only 180 lbs., fully equipped. The T-14, which operates at a constant speed of 3 knots for up to 2 hours at depths down to 230 ft., is designed for oceanographic research.

U.S. Seeks Oceanography Instruments

Industry told it must turn out inexpensive, rugged and accurate devices to support expanding effort; Navy to buy $46 million worth.

by William Beller

A GOVERNMENT COMMITTEE charged with rapidly developing America's knowledge of the sea has called upon industry to come up with the instruments that will be needed to do the job.

Suppliers of the oceanographic instruments will be well compensated. The Navy alone will spend some $46 million on such devices during the next decade—$1.5 million as a starter during this fiscal year. This will be part of the more than $900 million the Navy recently announced it will invest in oceanography from now through Fiscal 1970.

The money going into oceanographic work is fast increasing. Various government agencies have earmarked a total of $97.5 million for Fiscal '62. This is $44.5 million more than was spent during the last fiscal year.

This build-up is part of the national effort in oceanography proclaimed by President Kennedy in his inaugural speech and detailed in a message to Congress on March 29.

Adding urgency to the drive are reports that the Soviet Union has a fleet of 150 oceanographic ships—twice the number the U.S. has. Her fleet is known to include the world's only nonmagnetic ship, the Zarya, and a research submarine, the Severyanka.

• **Toward "meaningful program"**—The Interagency Committee on Oceanography (ICO) was set up by the Federal Council for Science and Technology in January, 1960, as a permanent committee within the Council. ICO's purpose is "to provide a coordinating mechanism among all government agencies engaged in oceanographic activities for the development of a meaningful national program."

To do this work, ICO has representatives from the Departments of Defense; Commerce; Interior; Health, Education and Welfare; State and Treasury, as well as the Atomic Energy Commission and the National Science Foundation.

ICO sponsored the government-industry symposium on oceanographic instrumentation, held in Washington, D. C. on Aug. 16 and 17. Here, nearly 700 industry and government representatives were briefed on the government's needs.

They were told that the instruments they come up with must be not only economical but rugged, easy to maintain and accurate. This is an old cry of all instrument users, but every speaker at this symposium sounded it with special emphasis.

Rear Admiral Charles Pierce, U.S. Coast and Geodetic Survey (Ret.), observed that skilled electronic and mechanical personnel needed to service complex instruments are hard for industry to recruit, train and hold on to —and that the problem is vastly more difficult for the Navy. He lamented that "the prevailing lower pay rates, long periods away from home and frequently crowded living conditions aboard ship are not conducive to retaining sea technicians aboard long enough to get their '20-year service pins.' "

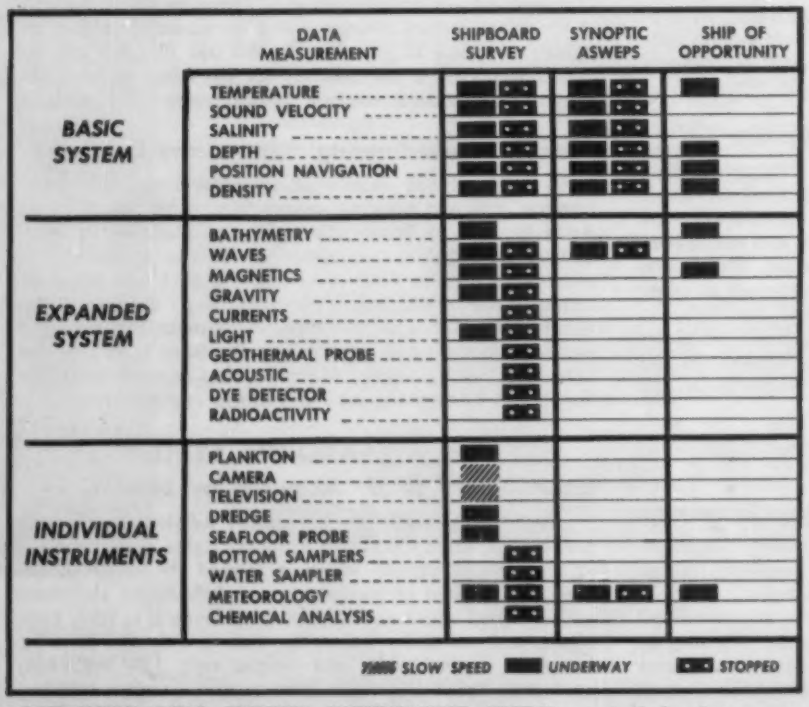
• **Work to be done**—Pierce complained that we have not scratched the surface in developing instrumentation for the tasks confronting oceanographic survey and research ships. He also noted that the cost of these ships is mounting steadily—a 3000-ton ship sometimes costing $3000 a day to operate.

Amplifying Pierce's point, Captain R. D. Fusselman, deputy hydrographer of the Navy's Hydrographic Office, said that it takes one ship 24 hours to complete what is referred to as "an oceanographic station." This means measuring and observing possibly two dozen physical, chemical and biological characteristics of the sea at a specific location.

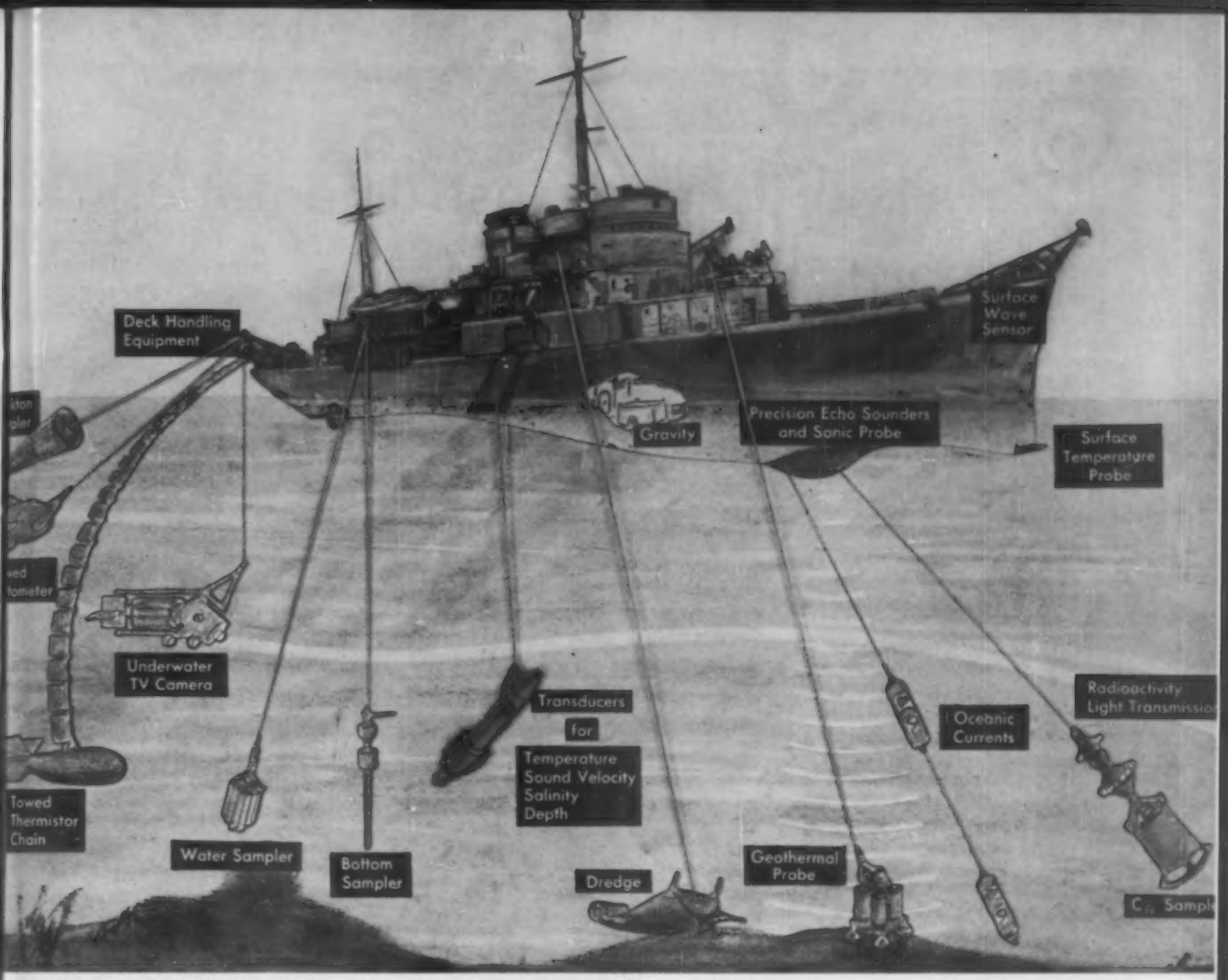
"Our objective is to reduce this time to two hours," Fusselman announced.

Another possible way to reduce the unit cost of oceanographic data gathering is to use aircraft and buoys to a greater extent. Aircraft would be by far the cheaper method—if suitable airborne oceanographic instruments were invented.

On the other hand, the problem of devising instruments for fixed buoys is



"OCEANOGRAPHIC SURVEY INSTRUMENT SUITS" required by Interagency Committee.



TYPICAL COMPLEMENT of instruments on present-day oceanographic research vessels.

much simpler. Yet the present designs of buoy systems are said to be naive and intuitively arrived at.

• **Water costlier than Scotch**—There are now only about 50 to 75 fixed, ocean-resistant scientific buoys on site for the U.S. Tens of thousands would be needed to probe the oceans.

The cost of operating buoys on a per-unit-of-data basis appears to be relatively low. An ardent buoy backer, Dr. William S. Richardson, scientist at the Woods Hole Oceanographic Institution, uses as a basis for comparison the cruise of a relatively small research vessel which during the International Geophysical Year made several Atlantic crossings in a little under four months. He maintains that this was an economical cruise in which shore leaves were few and no one charged the expedition for a flight home.

The chief measurements made were of ocean temperature and salinity. Exclusive of the price of the instruments, the average cost of each measurement was $21.75. Another example on the same trip showed that to capture a liter of water in a Nansen bottle cost $16.30 —which Richardson carefully noted converts to $11.70 a fifth, more than the price of 25-year-old Scotch.

By contrast, if a ship were to take the same length of time servicing a line of buoys, Richardson feels that the operation would be far more economical. For example, on the basis of actual operations the measurements of ocean current came out to cost 50¢ each. He predicted that refinements in technique and instruments could probably bring the cost down to as low as a dime a measurement.

A document of high interest and value to everybody in industry concerned with oceanographic instrumentation was released at the symposium—"Required Oceanographic Suit for Oceanographic Survey Vessels."

This 51-page description of the government's needs had its beginnings last October when the Hydrographic Office published special publication Number 41, entitled "Oceanographic Instrumentation." Then the following month, at a joint Office of Naval Research-Hydrographic Office meeting in Washington, D. C., 40 oceanographic experts further clarified the instrumentation needs. It was their final report that was given out.

At the same time, the Hydrographic Office distributed two similar documents, one for oceanographic instrumentation for ships of opportunity and the other for synoptic ships. ■

Approximate Number of Instruments Required for Research and Survey Operations

BASIC SYSTEMS	
ASWEPS	*45*
Ship of Opportunity	*56-163*
Survey/Research	*42-69*
EXPANDED SYSTEMS	
Survey/Research	*50-100*
INDIVIDUAL INSTRUMENTS	
Survey/Research	
Plankton	*41-52*
Camera	*42-88*
Television	*25-60*
Dredge	*41-52*
Seafloor Probe	*40-65*
Bottom Samplers	*41-52*
Water Sampler	*62-130*
Meteorology	*52-93*

Details of Ranger Instrumentation

THE LUNAR LANDING capsule for *Rangers 3, 4* and *5* is expected to contain a seismometer with accompanying amplifier, transmitter, antenna and power supply, a righting mechanism, temperature control system, zeroing motor and automatic calibration system.

The zero motor and calibration system are recent additions. The program is still reasonably fluid, and there may be other additions or deletions of equipment before the first capsule launch.

Jet Propulsion Laboratory is prime contractor for NASA's Project *Ranger*, Aeronutronic Division, Ford Motor Co., is capsule contractor, and Hercules Powder Co. will make the retrorocket.

The entire package weighs 900 lbs., including retrorocket. The actual instrumentation package for lunar landing weighs about 90 lbs. after separation from retrorocket prior to impact. A balsa wood "cushion" (M/R, June 19, p. 42) will provide impact absorption at optimum 30 meter per sec. velocity. Variations in retromotor performance may produce impact speed ranges as high as 70 meters per sec., for which balsa design also provides impact protection.

• **Shell layers**—Balsa was selected after studies of materials offering best crushing strength per pound. The problem of designing and fabricating an outside sphere from end-grain balsa was solved by covering the innersphere with a "jig-saw" pattern of precision-shaped balsa sections that fit so that only end-grain sections are exposed. Careful bonding of each section to adjoining sections provides maximum shock absorption from any direction.

Inside the balsa shell is a plastic "outer" shell. A thin layer of flotation fluid separates the plastic shell from the still-smaller inner metal sphere. Because of the temperature environments expected, it is assumed that the fluid is a refrigerant, such as freon, which will maintain low viscosity properties.

The floating feature permits the inner sphere and contents to rotate independently of the balsa-covered outer shell once a caging pin has been disengaged by the landing shock.

The main assembly inside the sphere has a center of mass below the flotation center, enabling instruments and antenna to slowly sink and come to rest aligned along a radius from the center of the lunar mass.

IN EARLY TEST of Ranger capsule, it was dropped from altitude of 1000 ft. to macadam surface. Instrumentation package, weighing 90 lbs., separates before impact.

A righting mechanism will position the antenna block—a small spherical segment occupying roughly the upper quarter of the total space—where it can radiate a pattern back to earth. Some electronics experts say the "reverse-dish" antenna surface under the balsa layer will radiate a pattern so broad that some error can be tolerated in landing in the designated target area and in righting the inner package.

Such drawings of the capsule as have been published indicate that after the sphere has stopped bouncing and rolling, and the inner package has settled down to an upright position, a puncturing device is actuated. This releases the flotation fluid and "freezes" the instrumentation in a near-erect position relative to the lunar surface.

• **Gentle but tough**—A battery pack at the package midsection forms an annulus around the seismometer. The seismometer is designed to operate for 30 to 60 days. It is expected to provide detection of seismic disturbances due to impact of meteorites on the moon—even if there is no internal lunar seismic activity.

Although the seismograph is so sensitive that it cannot function properly under the 1-g acceleration of earth, it is sufficiently rugged to withstand a 1000-ft. drop onto pavement—a peak of 10,000 g's—and still be operable.

Seismometer readings are amplified in the capsule electronics compartment —located, in the present configuration, below the antenna dish and above the instrument. Signals are transmitted through the balsa to earth stations.

• **Moderating** — Temperature control of the sealed inner package was apparently achieved by two methods.

In one, a relatively thick layer of a cryogenic-type insulation surrounds the package—but not the antenna section. This insulation may be layers of thin foil and foam.

The second method of temperature control uses pure water-filled metal chambers in all voids of the inner package. When internal temperatures increase during lunar "hot" days, the stored water temperature will rise to a pre-set value. Then a thermal control valve will open, permitting hot water to evaporate and thereby lowering the temperature. Water will gradually be lost, but not until capsule lifetime is reached.

During the cold lunar night, heat from electronics plus residual heat in stored water should help to some extent. Latent heat of vaporization released as the water begins to freeze is also helpful in holding the internal temperature above the design maximum limit until solar heat reaches the package.

As in satellite designs, capsule internal temperature can be determined by variations in transmission frequency. This information can only be roughly related to external lunar temperature, but the measurement costs nothing in payload. Temperature readings can validate design assumptions for the *Ranger* temperature control system. ¤

This camera watches the birdie

This is a ballistic camera, designed to photograph a missile in flight, and check its trajectory against a precise background of stars to detect the slightest deviation from course. It is the largest accurate ballistic camera ever built. Its 8-element, 600-mm, f/2 lens has an accuracy of 1 part in 200,000. Though the shutter is 12 inches in diameter, it opens and closes in 2 milliseconds. The entire instrument, including its unique lens and shutter, was designed and manufactured by Nortronics.

NORTRONICS
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CREATIVE ELECTRONICS BY RCA

NORAD ON THE ALERT

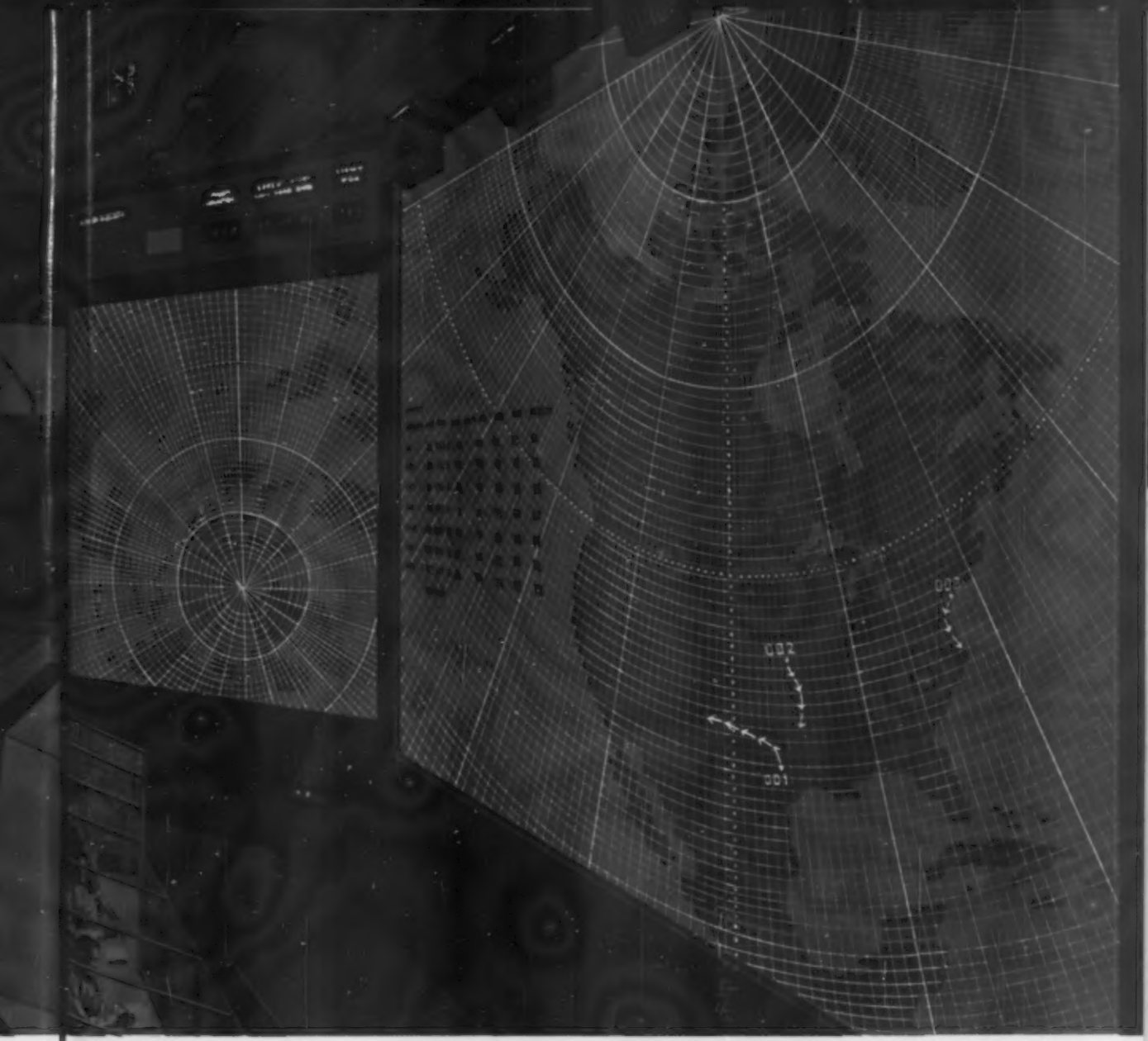
Inputs from BMEWS Provide Instantaneous Missile Data Direct to NORAD Headquarters

From our vast outer defense perimeter, over thousands of miles, to the nerve center of the North American Air Defense Command at Colorado Springs, the most advanced concept of data handling and checkout is being utilized in the BMEWS system. The stakes are high, for the purpose is defense of the North American Continent.

At BMEWS installations operated by USAF Air Defense Command, computers read out missile tracking data from giant radars. This information is simultaneously relayed to NORAD's Combat Operations Center.

The Radio Corporation of America is prime systems contractor for BMEWS. At the COC, RCA's Display Information Processor computing equipment automatically evaluates missile sightings, launch sites and target areas. By means of data processing and projection equipment installed by RCA and a team of other electronics manufacturers, the findings are displayed on huge, two-story high map-screens in coded color symbols, providing the NORAD battle staff with an electronic panorama of the North American and Eurasian land masses.

The handling of BMEWS inputs at NORAD is an example of how RCA data processing capabilities are assuring the high degree of reliability so vital to continental defense.



At NORAD Headquarters, RCA computing equipment, the Display Information Processor (control console shown here) receives sightings data from BMEWS and processes it for automatic readout.

RCA is prime system contractor for the sprawling BMEWS three-site radar network whose probing electronic fingers reach deep into space to provide early warning of missile attacks.

RCA's Automatic Checkout & Monitoring equipment continuously tests and checks performance of portions of the system and alerts an operator when a monitored signal exceeds certain limits.

Out of the defense needs of today a new generation of RCA electronic data processing equipments has been born. For tomorrow's needs RCA offers one of the nation's foremost capabilities in research, design, development and production of data processing equipment for space and missile projects. For information on these and other new RCA scientific developments, write Dept. 434, **Defense Electronic Products,** Radio Corporation of America, Camden, N. J.

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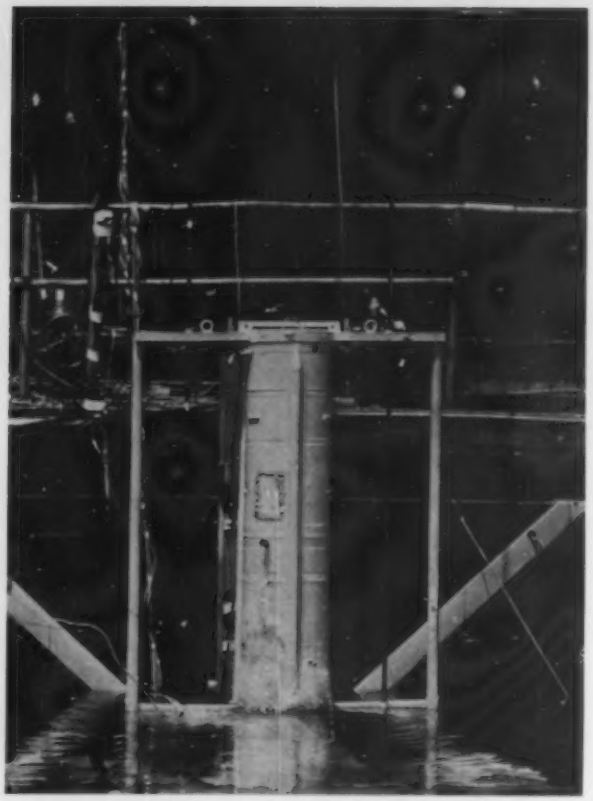
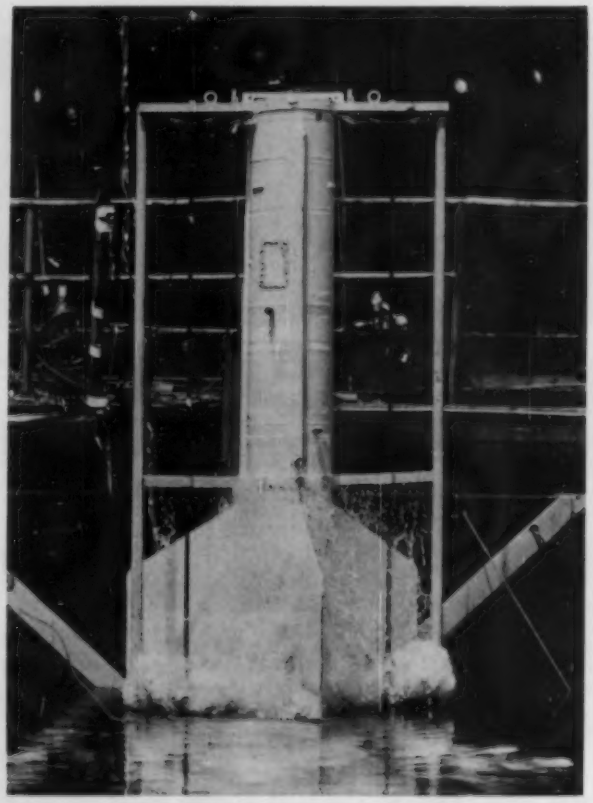
Hydra concept shown . . .

Aerojet Ignites Liquid Sustainer in Underwater Test

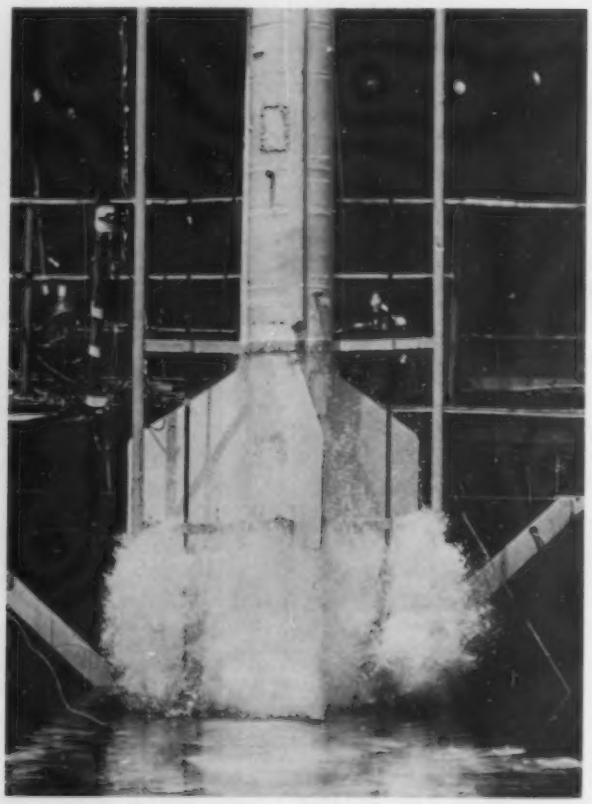
USING a water-filled, 25-ft. deep flame bucket, Aerojet-General engineers earlier this month successfully ignited a liquid-fueled Aerobee Junior sustainer in a captive test underwater. The umbilical connection was at the top of the rocket and out of the water at ignition. In the photo sequence here, the umbilical has dropped away a split-second after firing and the rocket is starting to rise. First the fins, then the whole rocket breaks clear of the water as it rises on 30-ft. shock cables. Aerojet said the test showed the feasibility of underwater launch of liquid-fueled rockets, which is contemplated under the Navy's Project *Hydra* concept. ¤



1. Umbilical drops (lower left) as Aerobee Jr. fires.

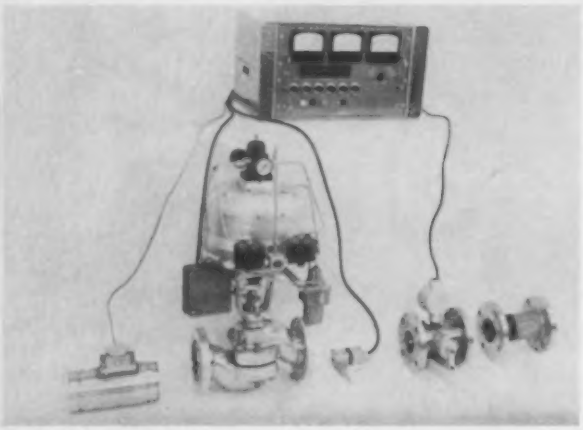


2. Note sealed access door, which was under water.

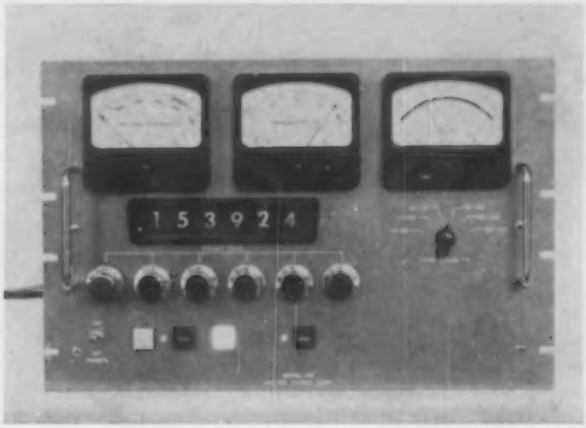


3. Rocket clears water; rising on 30-ft. tether.

Joshua Yields Precise Loading System



COMPONENTS of Potter Pacific's precision propellant loading system are held to minimum consistent with high accuracy.



ELECTRONIC CONTROL unit in Potter system constantly monitors propellant flow. It is checked out before delivery.

by Frank G. McGuire

EDWARDS AFB, CALIF.—Project *Joshua*—the Air Force effort to greatly improve propellants and their utilization in missiles—has brought about a number of new and highly precise systems for handling and loading non-cryogenic and thixotropic fuels and oxidizers.

One precision loading system with accuracies of ±0.05% by weight has been developed by Potter Pacific Corp. It has a minimum number of components, is rugged, flexible, portable and easily serviced in the field, and operates at low cost. The system supplies thousands of gallons of propellant to a missile within minutes, and constantly monitors the flow.

Usable with a wide range of non-cryogenic propellant combinations, the Potter system can be applied to a missile of almost any size, and can handle a number of missiles at a given base.

The system delivered to the Air Force here was specifically designed for use with pentaborane and hydrazine, but can accommodate almost any other combination, as well as the thixotropic —or jellied—propellants now under study and development.

• **Boosting accuracy**—Air Force project engineer H. E. Whitacre and Potter's chief engineer, W. C. Mitchell, said the propellant loading system consists basically of turbine flowmeters and digital counters designed to command valves to close when preset volumes of propellants are delivered to missile tanks.

Aside from this basic makeup of the system, special techniques are employed to enhance the accuracy. The Potter flowmeters can get precision reproducibility of ±0.01% over a narrow range of flow, and advantage has been taken of this by using equipment to control the liquid flow rates to constant values during loading. Flowmeters used for total flow measurement are simultaneously used to sense control rate for control purposes.

Because the flowmeters are volumetric devices, temperatures must be known before mass delivered can be calculated. The system therefore includes accurate multiple-range temperature measurement bridges; charts then tell the operator what correction to introduce into the counter so that a given mass is precisely loaded. Fluids are recirculated through the system and back into the tanks several times in order to equalize temperature so that the average can be determined.

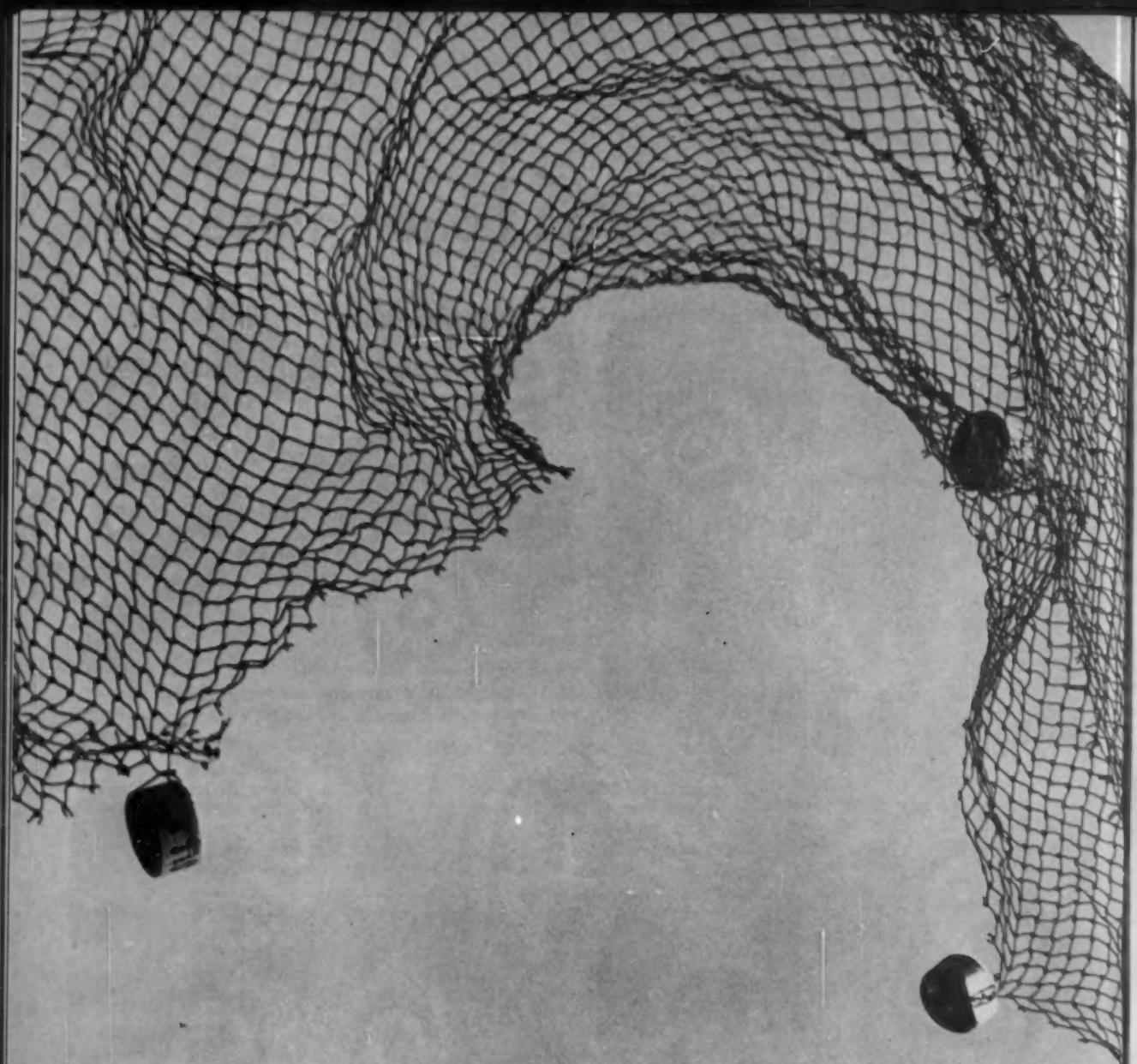
Flow switches are placed in the delivery lines adjacent to the missile, ensuring that the flowmeters do not start measurements until liquid actually enters the missile tanks. This eliminates fluid remaining in the lines from the measurement calculations. Repeatability of valve closing time is enough to maintain system accuracy, and the electronic control unit compensates for liquids which enter the tanks between command signals and full valve closure.

A monitoring function is served by a six-digit readout device showing the count stored in the control unit. Not essential to actual operation of the system, this unit establishes how much flow occurs after the flow control valves receive command signals to close. It also acts as a memory of how much total flow has occurred, in case it becomes necessary to interrupt delivery.

Complete checkout of the electronic control unit and other subsystems is provided for before each delivery. Flow control valves can be opened and the flowmeter braked to provide for gas purging of the plumbing. Most components are of stainless steel, making them compatible with a broad variety of fluids.

• **Key numbers**—Output signals from the flowmeters are sinusoidal, with frequencies proportional to the volumetric flow of the fluid. For *Joshua*, flow rate was set at 400 gpm, with a maximum of 1000 gpm being the upper range of the system.

The output signals have a scale factor on the order of 60 cycles per gallon; the exact meter scale factor must be known in advance in order to determine the numbers to be set into the control unit entry switches. For example, if the volume to be delivered is 2000 gallons, and the meter factor is 60 cycles per gallon, the number to be entered is 120,000. The measured temperature of the liquid modifies this num-



3-nation net into space

Goldstone, Calif., Woomera, Australia. Krugersdorp, South Africa.

Three different parts of the world thousands of miles from each other. Yet drawn together in a new and unique communications net: the Deep Space Instrumentation Facility.

DSIF is under the technical direction of Cal Tech's Jet Propulsion Laboratory for the National Aeronautics and Space Administration. Staffed and run by the host countries, the tracking stations will have 85-feet-in-diameter antennas, capable of transmitting and receiving. These giant, revolving steel and aluminum saucers are able to send and receive signals hundreds of millions of miles to and from space.

It was at Goldstone that JPL bounced signals off the planet Venus—35-million miles away. This two-month experiment gave us valuable data about the distance and surface of Venus and helped maintain the United States as the leader in planetary radar astronomy.

Communicating with deep space probes is just one function of the three stations of DSIF. Their primary job is tracking all the spacecraft designed by JPL to fly-by, orbit, and land on the moon and planets. Because the stations provide 360° coverage around the earth, one of the three will always be in contact with each distant spacecraft in flight and after it arrives.

DSIF is an essential participant in the many space projects at JPL: Ranger, Surveyor, Mariner. Some of these spacecraft are imminent. Others are on JPL blackboards. All will bring new technologies, new knowledge of our planets and the topless universes beyond, and a step greater understanding of our own small world.

To carry on these vital projects, we need top scientists and engineers of many different disciplines. We need people who love their work, who want to know, and want to participate in the exploration of other worlds. If you believe you're qualified, then come explore with us. Write today.

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• To develop computer programs for solving engineering problems. Must have M. S. in mathematics or related field, knowledge of numerical analysis and ability to use a digital computer.

• To design and analyze ballistic and ion-propelled trajectories for lunar and interplanetary probes. Must have M. S. in Physics, Astronomy or Engineering Science and two to four years experience in celestial mechanics, trajectories and data analysis.

• To study space communications codes for efficiency, error correction, security, reliability, guidance and control. Must have Ph. D. with one year's experience or M. S. with three years' experience in discrete mathematics and applications to information theory, coding problems, and statistical communication theory.

• To study technical and economic feasibility of advanced facilities for vacuum technology, thermal and optical radiation, cryogenic and hydraulic flow systems. Must have at least a B. S. in Mechanical or Electrical Engineering and 6 to 8 years experience (some outside aviation industry) in broad engineering development and/or design.

Other opportunities exist for electronic engineers and physicists in many areas at JPL. Send complete qualification resume now for immediate consideration.

All qualified applicants will receive consideration for employment without regard to race, creed or national origin/U.S. citizenship or current security clearance required.

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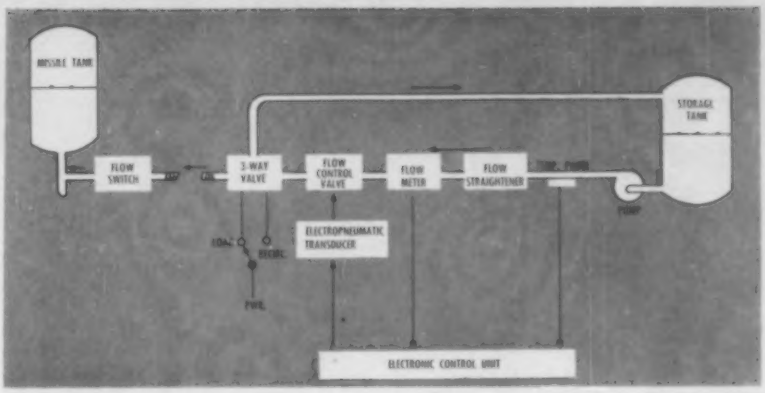


FLOW CHART shows how fuel moves from tank to missile.

ber in actual operation, and another alteration is made upon determination of the amount of flow occurring after valve closure signals have been transmitted, but before flow has fully stopped.

Flow straighteners in the system consist of bundles of stainless steel tubing housed in various sections of pipe. These eliminate turbulent and nonlaminar flow, either of which might reduce performance of the flowmeters.

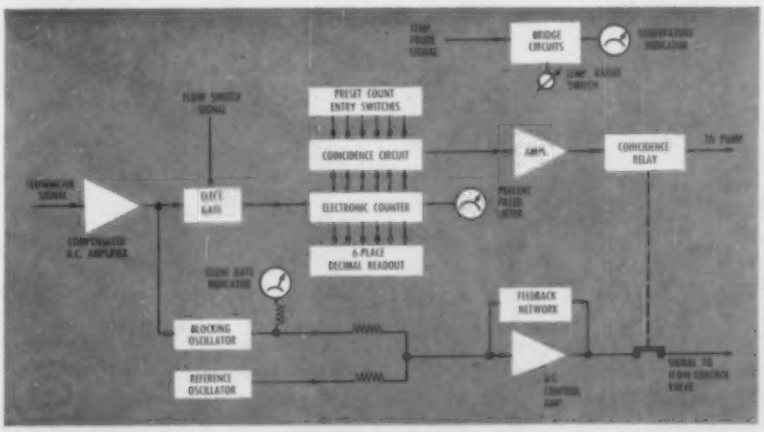
At the missile end of the delivery lines, flow switches are positioned in a housing containing a vane which is used to actuate a miniature switch when flow exceeds a minimum rate. The vane will not be actuated by air rushing through the plumbing ahead of the fluid.

Accuracy for the temperature measuring units is $\pm 0.2°F$ and measurement response time is in seconds. Reading of the average temperature is made after the electronic control unit is put into its "ready" mode and the pumps have recirculated the fluids through the tanks and system. Six ranges in this equipment cover the spread from zero to 150°F.

After the predetermined cycle count is fed into the entry switches, the mode is changed to "delivery" and flow starts into the missile. A subsystem designed into the setup maintains delivery rates at exactly the desired level—in this case, 400 gpm. Response time of this subsystem is about one second, considered quite adequate for an operation consuming several minutes. Both pressure surges and drops are counteracted by this device.

The "Percent Filled" meter on the face of the electronic control unit is adjustable for any scale of delivery to be made, and the "Flow Rate" meter is calibrated from 0 to 500 gpm.

The equipment is now being modified so that corrections are automatically applied to the preset count, based on temperature, and the recirculation phase of the operation may be eliminated. Another modification will be the inclusion of automatic digital scaling of the flowmeter signal, providing for entry and readout of the propellant amounts in meaningful mass units. Entry dials and readout devices will be calibrated in pounds, thus eliminating the charts presently used for signal translation. ⌗



ELECTRONIC circuitry involved in Potter Pacific system.

Taking Heat out of Solid Case-making

'Ardeform' cryogenic stretch-forming has no size limits, costs less than usual methods

by John F. Judge

A NEW CRYOGENIC metalworking process aimed at solid-rocket motor case fabrication which eliminates dependency on heat-treat furnaces is operational at Arde-Portland, Inc., Paramus, N.J.

Designated Ardeform, the process is essentially a cryogenic stretch-forming method. The basic principle is that cold-working at extremely low temperatures tremendously improves the room-temperature strength of austenitic stainless steels.

• **Roll and weld**—The first step in Ardeforming is the fabrication of the undersized preform. For cylindrical vessels, annealed sheet stock is used as received to make the sections. Inexpensive roll and weld techniques are employed, but high-quality welds must be achieved to permit the considerable amount of stretching that takes place—up to 13% in diameter.

The preform is placed inside a stainless-steel forming die in the steel forming tank. The die is simply a rolled and welded cylinder of specified diameter. The preform is clamped to prevent floating and filled with liquid nitrogen to a level well above that of the preform.

The preform is then filled with liquid nitrogen and sealed off except for a pressurizing line which leads to a supply of compressed nitrogen gas. The outdoor stretching pit is covered with a blast mat. The rest of the operation is controlled from a blockhouse.

When the preform reaches the liquid nitrogen temperature, it is expanded by admitting gaseous nitrogen. A sharp rise in the pressurization rate indicates the preform has reached the die. Final pressure may exceed first contact pressure by as much as 12%.

Pressure is vent-released and the vessel removed from the tank. After being drained it is returned to the plant for final machining.

In the vessels produced to date, Arde has demonstrated nominal tensile strengths of 285,000 psi—equivalent to strength-to-weight ratios of more than 1 million inches.

With suitable design and materials selection, nominal tensile strengths should reach 400,00 psi and strength-to-weight ratios of 1.4 million in., says B. Aleck, research director and developer of the process.

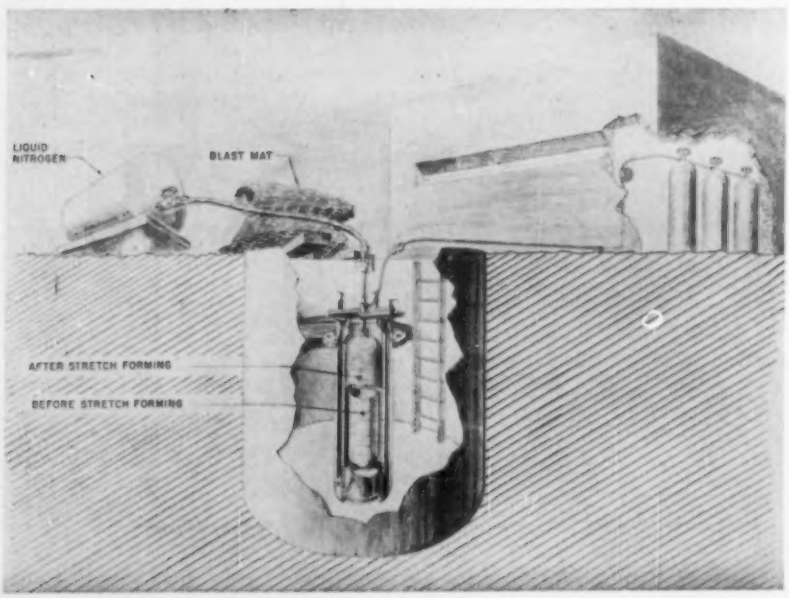
Chambers of 301 stainless have been processed to yield ultimate tensile strengths of 260,000 psi. Most of the operations have been with this material, but the firm has worked with AISI 302 and 304 steels.

Aleck says the process should prove effective with all other austenitic stainless steels. Studies with aluminum and titanium are in a very early stage, but the results look promising.

• **No size limits**—The steel best suited to Ardeforming appears to be 301, because it achieves its maximum strength with a minimum of working. The steels with higher nickel content require more reduction to produce a given strength—but 302 may be preferable where greater local ductility is desired in the preform.

In contrast with conventional motor-case forming methods, Ardeforming has no size limitation. The largest motor cases that can be handled in currently available heat-treating furnaces are approximately 12 ft. in diameter.

A wide latitude is also permitted in



PILOT FACILITY currently in operation at Arde-Portland's plant in South Portland, Maine. The large outer pit is 12 ft. deep and 10 ft. wide. Preforms fit in the insulated center tank along with the forming die.

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CHAMBER AT LEFT is an unstretched 301 preform with a nominal tensile strength of 102,000 psi. The swelled 301 case on its left has been Ardeformed to tensile strength of 260,000 psi. Process has also been used with AISI 302 and 304 steels.

FROST-COVERED CHAMBER is removed from the Ardeforming tank immediately after being stretched. The vessel is still at liquid nitrogen temperatures.

dimensional control during fabrication of the basic preform. No attempt is made to control out-of-roundness, straightness or diameter dimensions of the preform during welding. All kinks, bends, dents and distortions are removed during the stretching.

Preforms are welded without fixtures, and weld shrinkage occurs without restraint. These conditions result in a crack-free weld with a minimum of residual stresses. Conventional metalworking requires heated, internal-expanding, welding fixtures as well as expensive straightening operations to remove distortions due to heat treating and welding.

The preform needs no intermediate machining and there is less excess stock removal during final machining.

The stretching operation also serves as a proof test of the vessel. Chambers which pass successfully through the stretching operation will also pass the final hydrotest. Among other things, this means a lower scrap loss to the fabricator. Scrapping a vessel immediately after stretching eliminates the costs and times of the usual intermediate operations—straightening, final machining and hydrotesting.

• **Shortcomings** — Ardeforming is not without its drawbacks. More care is required in designing the basic preform. To obtain a finished pressure vessel with spherical heads, the preform heads must, for obvious reasons, be painstakingly designed with regard to material and thickness.

The main disadvantage is the need for dummy heads in the fabrication of open cylinders. To make a simple, open-end cylinder, the preform must still be a closed container. This involves two extra welding and cutting operations. But Arde spokesmen say that the total cost of the processed cylinder is still less than that of a comparable item formed conventionally.

Because the preforms must completely fill the die, certain attachments cannot be welded until after stretching. Welding heat then locally weakens the structure. Arde gets around this by returning the vessel to the forming pit for cryogenic restretching—without a die—but at pressures slightly under the original stretching pressure. This brings the weld strength up to par.

• **Cost playoffs**—The company ran a cost comparison between Ardeforming and conventional methods in the case of an improved motor chamber for an existing air-to-air missile. Lot quantity was pegged at 150. Two comparisons were made.

In the first, a 301 stainless Ardeform case of 240,000 psi yield was matched against a 4130 conventional case, heat-treated to 170,000 psi yield. The Ardeform ran about 15% less in cost.

The second round matched the 240,000 Ardeform chamber with a 240,000 psi D6AC case. The Ardeform came in at a cost figure almost 38% below the vacuum-melted, conventionally formed chamber.

An Ardeform facility capable of 25 chambers per shift would cost under $35,000—an extremely low initial facility pricetag.

In the big booster area, Arde-Portland spokesmen say that a 14-ft.-diameter, 240,000-psi case can be fabricated in 9 separate steps as against the 16 or more that current methods require.

Cases have been stretched as much as 22% in diameter. In this instance, the vessel burst, but experimental chambers have been stretched farther than the 13% case mentioned earlier. Aleck says the amount of stretch is a factor in the strengthening process but there is a leveling-off point at which the room-temperature tensile strength does not greatly increase. This is a characteristic of the material.

Basically, Ardeforming is applicable to any operation involving a die. It is possible to form components with sections of varying thickness. The inclusion of bosses and other attachments to cylindrical pressure vessels is not considered a major problem. End closures with four off-center ports are as easily handled as one with a single centered port. The rate of expansion in the die is not considered critical: it is more a function of the facility. Arde has not experienced any difficulty to date.

The firm is currently fabricating prototype solid-motor chambers, mostly in the small air-to-air category. Helium storage spheres are also being produced. Arde-Portland expects to obtain contracts in both areas, as well as for a large prototype solid-booster case.

Research and development of the process was carried out with company funds bolstered by R&D funds from Army Ordnance and BuWeps. Other potential applications include lightweight, high-strength torpedo cases and ultra-strong tubing of varying cross-sections for weight-critical applications.

The strengthening characteristics of cryogenically working steels are well known, but the main difficulty has been that welding reduced the yield in the weld area by more than 80%. Ardeforming cold-works the welds as well as the base metal, avoiding this limitation in fabrication. ■

Foreseeing heavier belts . . .

Astronomers Blast West Ford Go-ahead

Administration's statement fails to convince IAU and others; problem complicated by secrecy shrouding plans

RADIO AND OPTICAL astronomers around the world are protesting President Kennedy's decision permitting the Air Force to proceed with Project *West Ford*—a communication experiment proposed by Lincoln Laboratory of the Massachusetts Institute of Technology.

West Ford—first proposed by Lincoln Lab in the fall of 1959—would place approximately 75 pounds of hairlike, tuned copper dipoles into an undisclosed orbit around the earth to investigate the technical feasibility of using the dipoles as passive reflectors for communications and to assess the effect of this technique on space science or on other branches of science (M/R, Sept. 19, 1960, p. 60).

• **Heavy opposition** — Vehemently opposed to the project are many members of the International Astronomical Union, which wound up its 11th General Assembly Thursday in Berkeley, Calif. During the ten-day session, the IAU's Commission on Radio Astronomy voted unanimously to condemn the project and the Belgian delegation submitted a resolution opposing the experiment for a vote of the assembly.

Four days prior to the IAU meeting, the President's science advisor, Dr. Jerome B. Wiesner, released a policy statement from the National Aeronautics and Space Council in an effort to reassure the scientific community as to the goals of the experiment.

"No further launches of orbiting dipoles will be planned until after the results of the *West Ford* experiment have been analyzed and evaluated," said the statement, which according to Wiesner had been approved by President Kennedy. It also guaranteed that any future experiments of this type would be contingent upon "the development of necessary safeguards against harmful interference with space activities or with any branch of science."

• **Astronomers skeptical** — Prominent members of the Astronomical Union, however, were skeptical of the declaration. They pointed out that although this experiment would probably be harmless the government must intend to exploit any success achieved with future and denser belts—or there would be no reason for conducting the test at all.

Concern was also expressed over the statement that future systems would be contingent on the evaluation of the results of the initial test. This brought up the question of who would make this evaluation and who would make the decision on placing more substantial belts of particles into space.

The decision of the Administration to continue with *West Ford* is based on the military value that such a system may have. Particularly in the Arctic regions, where communications are highly unreliable due to the absorption of radio signals by the dense layer of ionized particles, the system would provide a means of recalling SAC bombers in the event of a false alarm.

• **Classification problem**—Much of the controversy stems from the project's classified nature, which prevents a detailed analysis of the implications of the test. The calculations that astronomers have been able to make have been based on fragmentary information and vague statements about the orbital parameters—such as the illuminating statement that the belt will be "a few thousand kilometers" away from the earth. Even the "appropriate information on a timely basis" concerning the launch date is unavailable to astronomers, in spite of the fact that the Space Council's policy statement calls for the release of such information.

The intense criticism of Project *West Ford*, according to one White House source, is unlikely to materially affect the decision to continue the experiment. However, this official indicated that the project might be in for another Space Council review. ¤

Minuteman Motor Embarks for Cape

FIRST-STAGE MINUTEMAN engine is loaded aboard C-133 at Hill AFB, Utah (near Thiokol's Brigham City plant), for trip to Canaveral and first "silo" flight test.

—industry—

COLLINS RADIO CO. has integrated all its microwave activities into one organization within its new systems division, the Alpha Corp.

The realignment will unite sales, systems engineering, contract administration, training and customer service. Alpha Corp. was formerly a subsidiary of Collins.

AVIEN, INC. transferred its laser and maser research program from Cambridge, Mass., to the company's corporate R&D dept., Woodside, N.Y. The company has also sold the ownership of its Trident Corp. subsidiary in Cambridge to Maser-Optics, Inc. of Boston.

GENERAL ELECTRIC opened a lab for testing industrial and aircraft true-mass flowmeters at the company's West Lynn, Mass., Instrument Dept.

The new installation will perform experimental and product evaluation tests on all industrial and aircraft liquid mass flowmeters built by the Instrument Dept. Facilities for engineering, research and development of mass flowmeters are located in the new lab.

SHEPHERD INDUSTRIES, INC., Nutley, N.J. has pooled management, manufacturing and sales capabilities with KPT Mfg. Co., Roseland, N.J., and Sinso Electronic Products, Inc., Union, N.J.

KPT specializes in research, design and manufacture of precision mechanical, electro-mechanical, and hydraulic systems, assemblies and components.

WYLE LABORATORIES established a field engineering office in Huntsville, Ala., to be followed by establishment of a testing lab. Lab operations will begin, Wyle says, when suitable plant facilities can be acquired.

First Huntsville facilities planned by Wyle are standards and calibration labs. These will be followed by environmental simulation facilities, including high-force vibration equipment, and facilities for functional operation of various types of aerospace components and systems.

SPACE EQUIPMENT CORP. has been formed in Torrance, Calif., to design, develop and manufacture missile, space and industrial products. Founder and president Edward J. Horkey said the firm will be active initially in electromechanical and electronic ordnance systems and components, and high-strength structures of high-temperature plastics and rubber.

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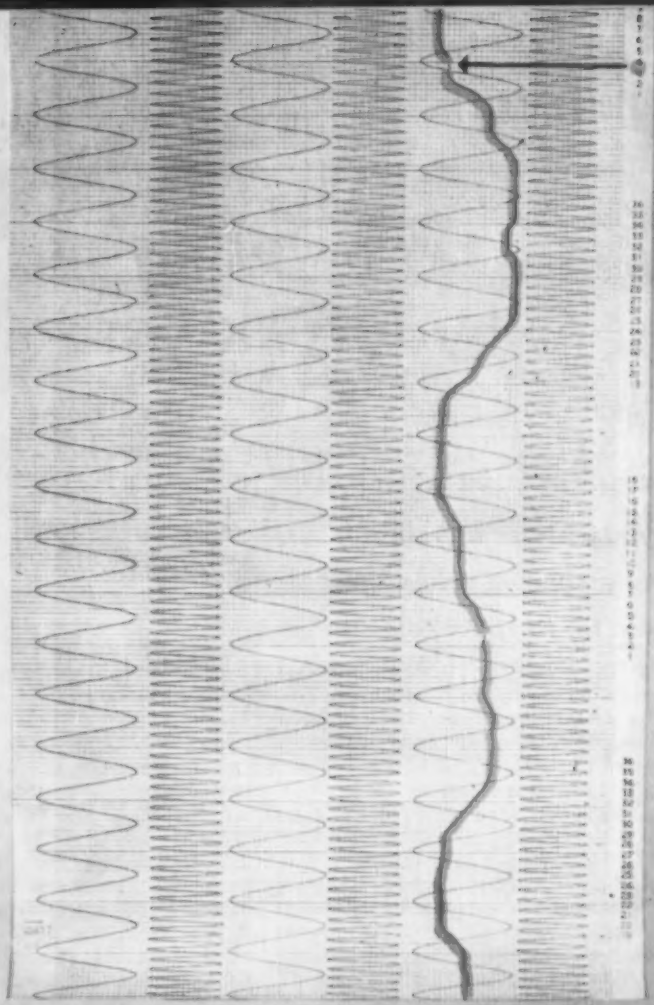

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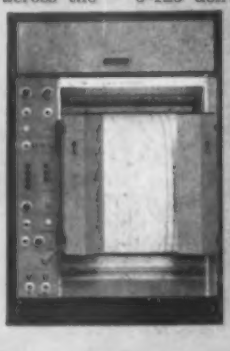

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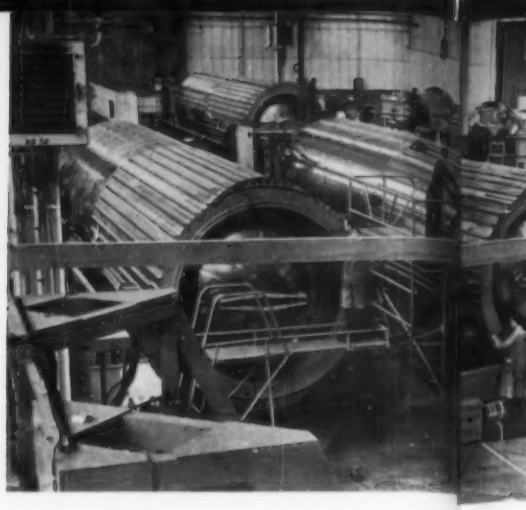
First Details of Blue Streak Booster



DE HAVILLAND's Blue Streak production line in Hertfordshire.

British are hiking thrust to 300,000 lbs. and plan to test Atlas-like vehicle at Woomera for its space role

IN ANTICIPATION of its use as a European satellite launcher, the British this week reported the first technical details of the *Blue Streak*—including plans to uprate thrust to 300,000 lbs.

The 61.5-ft. *Blue Streak* was proposed as the first stage of an international three-stage satellite launcher capable of putting 2200 lbs. into a 300-mile-high circular polar orbit. A French-built second stage has been proposed, along with a possible hydrogen-oxygen-fueled third stage to increase payload capacity to 3400 lbs. Who will build the third stage has not been determined.

Since its cancellation as an IRBM in April, 1960, the British have continued development of *Blue Streak* on a limited basis and are presently planning R&D flights from Woomera, Australia. Only now, however, have they revealed precise engineering data of the vehicle, which some British engineers claim "is as up-to-date in design as any of its American counterparts."

In many respects the *Blue Streak* resembles the General Dynamics/Astronautics *Atlas*, and this is not surprising. After work was started on the IRBM in 1955, agreements were worked out by de Havilland, the prime contractor, for an exchange of information with G-D/A. Rolls-Royce Ltd., *Blue Streak*, engine developer, made a similar arrangement with the Rocketdyne Division of North American Aviation Inc.

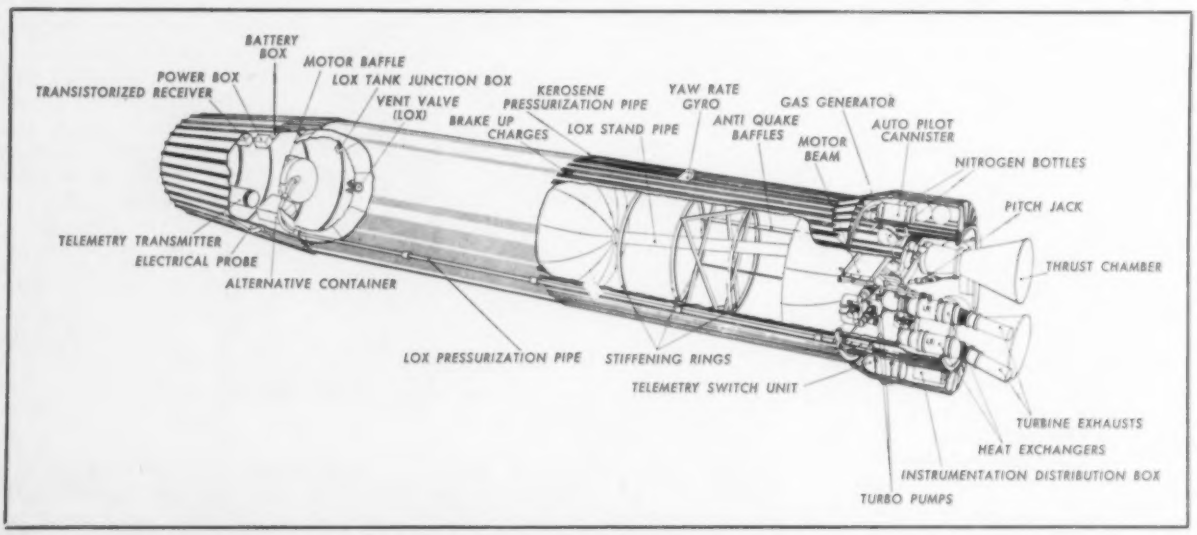
The result was a one-stage vehicle 10 ft. in diameter powered by two gimballed engines, each developing 137,000 lbs. thrust. (They are being uprated to 150,000 lbs. in the space booster.) The tank structure, like *Atlas*, is .019-in.-thick stainless steel with integral LOX and fuel tanks. Launch weight is 92.2 tons and weight at burnout 6.1 tons.

• **Propulsion data**—The two RZ.2 rocket engines are installed as separate units, each with its own propellant feed, combustion and control system. Propellant feed is by turbopump to a regeneratively cooled combustion chamber of tubular-walled construction. Thrust chamber pressure at the injector is 525 psig.

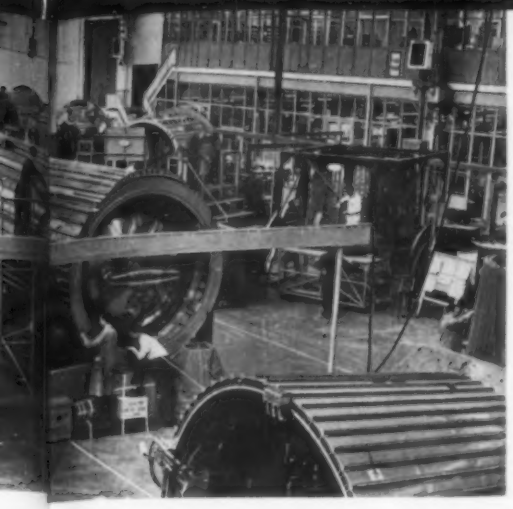
A complete engine weighs 1500 lbs. Together, the two *Blue Streak* engines consume 60.8 tons of LOX and 26.3 tons of kerosene (a fuel mixture of 2.25/1) in a 180 sec. maximum firing.

The LOX system requires a 28.5 psig tank pressurization while working and 4.3 psig while empty. Maximum LOX pump flow is 390 lb./sec. at 785 psig. The pump impeller has a diameter of 11 in.

Working tank pressurization of the kerosene system is 10.25 psig; empty pressure is 1.5 psig. The pump delivers a maximum flow of 170 lb./sec. at 735 psig. The impeller has a diameter of 12.5 in.



CUTAWAY DIAGRAM shows intricate details of Blue Streak, which Britain has proposed for use as the first-stage of a three-stage launcher vehicle for a joint European space satellite program.



A 0.35 oxygen-to-fuel rich mixture is burned in a separate gas generator to drive the pump turbines, which operate off a simple spur reduction gear. Turbine output is 2400 H.P. at 30,000 r.p.m. The pump speed is 6000 r.p.m.

Like the *Atlas*, the vehicle has a ladder-type electro-pneumatic sequential control system for operating various valves during start and shut-down. The system prevents any given operation from taking place until a signal has been received indicating the immediately preceding operation has been completed satisfactorily.

The guidance and control system is hydraulically actuated off of an autopilot. Motor gimballing freedom is 7°, permitting a 0.7° sec. programed turnover rate. Hydraulic H.P. is 3000 psig and hydraulic L.P. 200 psig.

• **Ten R&D flights**—Under the plan advanced earlier this year at the Strasbourg conference for the joint European space program, it was envisioned that the developmental program would cost some $200 million over a five-year period. This would involve 10 firings using the first stage—the last three being attempts at injecting satellites into polar orbit from Woomera.

However, these would be only test satellites designed to determine conditions imposed on them by powered flight and to resolve problems of third-stage separation and residual motion.

No firm plans have been developed for the type of satellites to be launched once the vehicle becomes operational. There is considerable British sentiment, however, in favor of a commercial communications system. One study by Hawker-Siddeley has backed such a system using eight satellites.

No details have been divulged about the specifications for the French-built second stage—outside of a requirement that it increase the 8500 m.p.h. speed of the vehicle at booster burnout to 14,500 m.p.h. and take it to 105 mi. altitude. ¤

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soviet affairs

By Dr. Albert Parry

Biotelemetry as a space science

is discussed by R. Bayevsky, a candidate of the medical sciences, in a recent article "Biotelemetry and Flight into the Cosmos" in the Moscow daily *Ekonomicheskaya Gazeta*. "Radiotelemetry is the basic means of research in space medicine," he says, "Biotelemetry, its special branch devoted to biological measuring at a distance, has emerged at the crossroads of biology and radiotechnology, and it unites the latest achievements of both these sciences."

The author traces biotelemetry's beginnings to aviation medicine and sports medicine. He divides all biotelemetric systems into two basic categories: dynamic and static. The former allows for free movement of "the object under investigation"; the latter limits movement.

Space flights demand very special

performance from biotelemetry, Bayevsky points out. For space flights, biotelemetric equipment has to be small in size and light, as well as economical of energy. It should work with stability despite the rockets' vibration and acceleration. "The wide application of radiotelemetry in space medicine," he goes on, "compels researchers to pay serious attention to the problem of coordinating the volume of the transmitted information with the capacity of channels of such relay."

Relaying of parameters of muscular bio-currents, for instance, calls for a very wide band of frequencies. On the other hand, a narrow band is needed for body temperature or breath, the transmitting of whose parameters is of comparatively low frequency. Therefore, "the sum total of the capacity of the radiotelemetric tract is proportionate to the width of the band of frequencies and strength of the transmitting equipment."

As space flights progress in distances and duration

they will cause a decrease in the capacity of radiotelemetric channels, since—as Bayevsky explains—"the band of transmitter frequencies will have to be narrowed in order to preserve the strength of the radiotransmitter." And yet the inevitable ramification of space-flight research will lead to "a considerable increase in the number of parameters to be registered." The answer, the author says, is in cybernetics, which science has already created effective methods of programing of various types of data. Channels of small capacity can be utilized, thanks to programing, to increase the contents of information in each signal.

Physiological research methods in space medicine

involving the use of biotelemetry are discussed by Bayevsky under these headings: *Electrocardiography*, to watch the astronaut's heart muscles. *Phonocardiography*, to register the astronaut's heart-tones with the aid of miniature microphones fastened to his chest. *Arterial oscillography*, to measure the astronaut's blood pressure and "the state of his peripheral vessels." *Pneumagraphy*, to test, with spirometric masks and in other ways, the frequency and depth of the astronaut's breathing. *Electromyography*, to register, with electrodes, muscular bio-currents. *Actography*, to measure the degree of the astronaut's (or the dog's, the rat's, etc.) physical activity (movement) while in flight, with such counters as tensormetric, contact, piezoelectric, etc.

Modern electronics can now implement

an idea which, Bayevsky says, until recently "has seemed fantastic—to build a multiple-channel radiotelemetric transmitter no bigger than a pocket cigarette-case." This, he implies, has tremendous bearing on further progress of Space-Age biotelemetry.

He mentions the American success in creating a miniature transmitter that can be placed on the back of a mouse. It is true, Bayevsky adds, that this equipment can transmit over a very small distance only —no more than a score or two centimeters, but both American and Soviet scientists continue to work on the improvement of such miniaturization to increase effectiveness over greater distances.

letters

(Continued from page 6)

and fiscal employees. Thus, our recruitment "publicity" has been doing the job intended and not whatever devious tasks hinted at by Mr. Burns.

Mr. Burns should be grateful that MISSILES AND ROCKETS is willing to treat controversial issues fairly. The role of organizations engaged in the struggle to combine technological leadership and deterrent strength within a framework of cost/time/effectiveness needs all the clarification responsible editors can provide.

L. R. Allen, Jr.
The MITRE Corporation
Bedford, Mass.

Recover the Capsule

To the Editor:

Our second space shot with Capt. Grissom on board certainly has been a great accomplishment. However, its value with respect to world-wide recognition has been badly influenced by loss of the space capsule. Despite many voices declaring that the loss is of only minor technical significance, the fact remains: we lost it.

As I see it, and everyone I have talked to so far agrees with me, the recovery of this capsule could be worked into an enormous propaganda victory.

All reports I have heard agreed unanimously that the capsule cannot be recovered. This I can't see at all—on our series of tests using the Bathyscaph owned by our Navy, we have proven that we can reach the deepest spot of any ocean and certainly a depth of 18,000 feet.

I believe that every true American would be proud to spend a few pennies or, if necessary, a couple of dollars each to contribute to another "American first."

We have established that we have the equipment and that we can get the necessary money. As for engineering problems, I am sure we can master them.

The technical details may be summed up as follows:

1. Establish exact location where the capsule was dropped.

2. Drop a similar capsule (may be one of the prototypes) from this spot and follow it with sonars and metal detectors all the way down. In all probability, it will land near Grissom's unit. Search for *Liberty Bell 7*.

3. Conduct a thorough search of the ocean bottom and the ocean currents for establishing the best salvage methods with the Bathyscaph, if necessary.

4. Modify, where necessary, the Bathyscaph and equip it with suitable salvage mechanisms. The blimp already has some electro-mechanical devices on board for navigation and dropping of its ballast.

5. Salvage the capsule—and play it up big in the press.

L. R. Siegl
Senior Project Engineer
The Hartman Electrical Mfg. Co.
Mansfield, Ohio

P.S. It would be very disappointing if the Russians recovered it before we did.

names in the news

FIQUETT

HOPPER

RYDEN

Cecil Fiquett: Former reliability and quality engineer, *Saturn* Project Office at NASA's George C. Marshall Space Flight Center, named to head Wyle Laboratories' new field engineering office in Huntsville.

Robert W. Kluge: Named director, Special Defense Program; **Sidney Stark,** director, Advanced Systems; and **Herman R. Staudt,** director, *Pershing* Ballistic Missile System Program, The Martin Company's Orlando Division, Fla.

Dr. N. L. Krisberg (USAF-ret.): Former vice commander of the Air Force Office of Aerospace Research, joins The Boeing Co.'s Aero-Space Division as assistant chief of technical staff.

Dr. Grace L. Hopper: Appointed director of systems research for Remington Rand Division, Sperry Rand Corp., New York City. With the company's Univac Division since 1950, Dr. Hopper is a nationally-known mathematician and is the originator of electronic computer automatic programing.

Dr. Isidore Hodes: Former consultant to Bendix Corp., appointed head of Plasma Physics Laboratory for the Aero/Space Dept., General Motors Defense Systems Division, Santa Barbara, Calif. Assisting Dr. Hodes is **Arthur A. Vuylsteke,** formerly of GM Research Laboratories Physics Dept.

John W. O'Hara: Former manager of Systems Engineering Div., Minneapolis-Honeywell Co., named to head the Industrial Electronics Dept., Systems Engineering Div., Aero Service Corp., Philadelphia.

Dr. Lester C. Van Atta: Appointed technical director, Hughes Aircraft Co.'s research laboratories, Malibu, Calif. While on leave from Hughes, Dr. Van Atta recently completed a year's service in Washington, D.C., as special assistant for arms control for the Director of Defense Research and Engineering in the Office of the Secretary of Defense.

Dr. M. John Rice, Jr.: Appointed director of engineering for Semiconductor Operations, CBS Electronics, manufacturing division of Columbia Broadcasting System, Inc., Danvers, Mass. Previously Dr. Rice was manager of semiconductor material engineering.

Brig. Gen. Bernard M. Wootton (USAF-ret.): Veteran of 30 yrs. service and former Commander of the Pacific AACS Area, joins Page Communications Engineers, Inc., Washington, D.C., as executive director of contract services.

Harry M. Sisson: Named director of administration; **Kenneth Bank,** division counsel; and **J. J. Hanrahan,** personnel and labor relations manager, for the Organics Division, Olin Mathieson Chemical Corp., New York City.

Jack W. Blanchard: Appointed chief engineer, Phoenix Electronics plant, Kaiser Aircraft & Electronics Div., Kaiser Industries Corp. Prior to joining Kaiser, Blanchard was senior project director and associate research engineer, University of Arizona, Tucson.

Roy A. Olerud and **William B. Croxville:** Named general managers of Industrial Electronics Division and Electronic Tube Division, respectively, Allen B. Du Mont Laboratories, Divisions of Fairchild Camera and Instrument Corp., Clifton, N.J. Olerud rejoins Du Mont from International Telephone and Telegraph Corp.; Croxville formerly was with Sperry Rand Corp.

Dr. Lorraine S. Gall: Named a specialist microbiologist in the Space Environment and Life Sciences Laboratory of Republic Aviation Corp.'s Research and Development Center, Farmingdale, N.Y. **H. C. Towle** appointed manager of the company's newly formed Systems Integration Section.

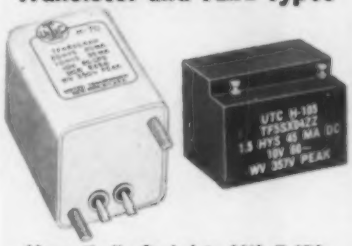
Arnold J. Ryden: Appointed to board of directors, Avien, Inc., Woodside, N.Y., filling the vacancy caused by the resignation of **William O. Boschen.** Ryden also is president of Midwest Technical Development Corp. and Telex, Inc., Minneapolis, and chairman of the boards of National Semiconductor Corp., Danbury, Conn., and International Properties, Inc., Minneapolis.

UTC

PIONEERS IN MINIATURIZATION

FILTER REACTORS

Transistor and Tube Types



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"H" SERIES of filter chokes have multiple ratings which make these units ideal for the complete gamut of military and industrial applications. Transistor supply units have two windings to further add to their flexibility These units are also made as swinging type to enhance the regulation of the power supply. The use of grain-oriented core materials, to obtain the highest permeabilities, has produced reactors of exceptionally high inductance for a given size. Inductance range: 7 hys to 20 hys up to 1 amp, also: 2 mhys to 2.5 hys up to 16 amps. Metal cased for class R and molded for class S temperature requirements.

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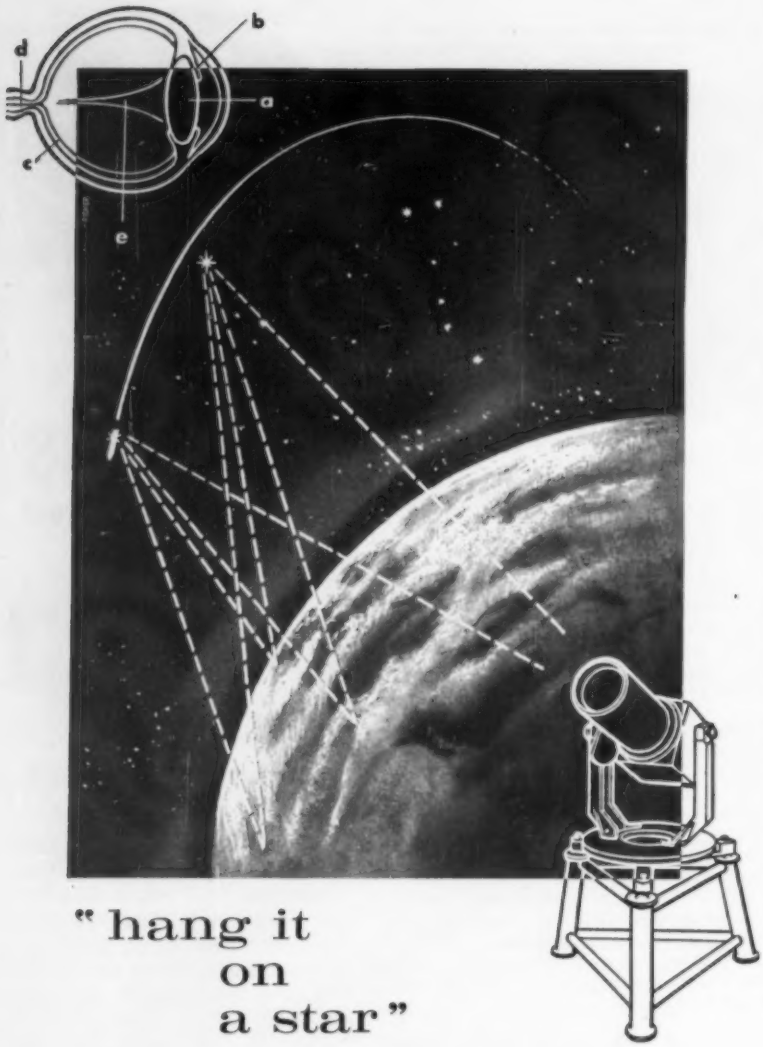

"hang it on a star"

ICF's design and engineering skill has developed the most accurate and versatile tracking system available today. It is PTS – a mobile Photogrammetric Triangulation System.

PTS incorporates two or more ballistic cameras. It is the only missile tracking system which can consistently produce data having a bias factor of substantially less than unity.

PTS recorded the orbit of Sputnik 1 with an accuracy of 20 milliseconds on the first attempt – it has performed even better since. Not only can it be used for missile and satellite applications, but for measurement of contour and deflections of structures such as radar antennas, bridges, buildings, airplane wings, and towers.

Above all, PTS is highly desirable in missile testing to reconcile conflicting trajectories by "hanging" them upon a ballistic camera trajectory which, in turn, is "hung" upon the stars.

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MEA Inc. 752

—contracts—

NASA

$3,224,183—International Business Machines Corp., Huntsville, Ala., for rental of electronic machines to compute administrative and scientific data for the *Saturn* space vehicle project (2 contracts).

$2,000,000—Ryan Electronics, San Diego, from **Hughes Aircraft Co.,** for design, development, and fabrication of radar altimeter and Doppler velocity sensor equipments for NASA's *Surveyor* lunar soft-landing vehicle.

$1,000,000 — Radiation Incorporated, Melbourne, Fla., for PCM telemetry ground equipment for the *Nimbus* weather satellite.

$993,559—Radio Corp. of America, Princeton, N. J., for development of a payload capsule for electrical propulsion system flight-testing.

$846,500—Flexonics Corp., Bartlett, Ill., from Marshall SFC, for design, fabrication and testing of vent, pressurizing and propellant feed lines on the *Saturn's* fuel and liquid oxygen system.

$450,000—Ryan Electronics, San Diego, for development and fabrication of high-altitude radar altimeters for the *Saturn* space vehicle.

$114,128—Space Technology Laboratories, Inc., Los Angeles, from Marshall SFC, for a study of the payload-carrying capabilities of current U. S. medium-class space vehicles, with respect to future satellites and mission requirements.

$98,264—General Dynamics/Convair, San Diego, for research on feasibility of using a magnetohydrodynamic (MHD) engine to propel vehicles through deep space.

$52,000—The Martin Co., Baltimore, from Goddard SFC, for study of effects of extended space missions on non-metallic materials.

MISCELLANEOUS

$547,984—Elgin National Watch Co., Elgin, Ill., for production of safety and arming devices used in *Sidewinder, Sparrow* and *Hawk* missiles.

$427,000—Gulton Industries, Inc., Metuchen, N. J., from **Grumman Aircraft Engineering Corp.,** for power storage and conversion systems for the *Orbiting Astronomical Observatory* (*OAO*) satellite program.

$321,000—American Orbitronics Corp., Hawthorne, Calif., from **Aerojet-General Corp.,** for missile components.

$767,000—Continental Electronics Mfg. Co., Dallas, subsidiary of **Ling-Temco Electronics, Inc.,** for BMEWS radar transmitter equipment.

$100,000—Industrial Electronics Dept., Westinghouse Electric Corp., Baltimore, for five 15-KW, dual-frequency RF generators for **North American Aviation Corp.**

Radiation Incorporated, Melbourne, Fla., from **Bell Telephone Laboratories,** for development, fabrication and installation of two automatic-tracking antenna systems for use with Bell System's experimental communications satellite. No amount disclosed.

Lockheed Aircraft Service, Ontario, Calif., from **MacDonald-Scott and Associates,** for testing and calibration of propellant-loading systems at nine *Titan* missile launch sites near Moses Lake, Wash.

NAVY

$1,800,000—Hughes Aircraft Co., Culver City, Calif., from BuWeps, for production of a new infrared device to measure small changes in temperature.

$1,000,000—Microwave Associates, Inc., Burlington, Mass., from BuWeps, for production of magnetron tubes.

$63,000—Daystrom, Inc., Pacific Div., Los Angeles, for control gyroscopes and spares provisioning data for *Regulus I* missile.

Circle No. 14 on Subscriber Service Card

Hughes Aircraft Co., Fullerton, Calif., for studies into the feasibility of integrating all communications, weapons, sensors, and command and control systems aboard a nuclear attack-killer submarine and a guided missile frigate to be built in '62-'63. No amount disclosed.

Radio Corp. of America, Burlington, Mass., for research and development of an autopilot system design for hydrofoil craft. No amount disclosed.

McCormick Selph Associates, Hollister, Calif., from Naval Air Development Center, for development of a miniaturized gas generator to inflate sonobuoy flotation bags. No amount disclosed.

ARMY

$70,685,283—**The Martin Co.**, Orlando, Fla., for *Pershing* weapon system (2 contracts).

$16,998,127—**The Martin Co.**, Baltimore, for design, construction and test operation of a 10000 KWe (net) floating nuclear power plant.

$4,031,455—**Raytheon Co.**, Waltham, Mass., for concurrent repair parts for the *Hawk* missile system; $113,330 for *Blue Streak* and emergency replenishment parts.

$357,103—**Sperry Gyroscope Co.**, Great Neck, N. Y., for field engineering services in support of *Sergeant* missile system.

AIR FORCE

$5,440,000—**Sperry Gyroscope Co.**, Great Neck, N. Y., for installation and testing of high-powered, long-range, frequency-diversity search radars.

$2,100,000—**Reconnaissance Systems Laboratories, Sylvania Electronic Products, Inc.**, Mountain View, Calif., for engineering and production of receiving equipment.

$2,000,000 — **Minneapolis-Honeywell's Boston division**, from **General Dynamics/Astronautics**, for rate gyroscopes for use in guidance systems on *Atlas* missiles.

$1,917,000—**RCA's West Coast Missile and Surface Radar Division**, Van Nuys, Calif., from **GD/Astronautics**, for *Atlas* missile launch control and checkout equipment (2 contracts).

$1,700,000—**Franklin Institute**, Philadelphia, for design, development, and construction of dynamic escape simulator for use in designing escape capsules for high-speed jet aircraft and *Dyna-Soar*.

$1,014,548—**The Martin Co.**, Baltimore, for repair and modification of *TM61/76A* missiles and related equipment.

$255,000—**Brush Beryllium Co.**, Cleveland, for continuation of development of production techniques for aircraft-quality beryllium sheet.

$250,000—**National Research Corp.**, Cambridge, Mass., for research and development on encapsulated ingredients for solid propellants.

$145,000 — **Space-General Corp.**, Glendale, Calif., for research into the feasibility of detecting underground nuclear explosions by means of electromagnetic signals.

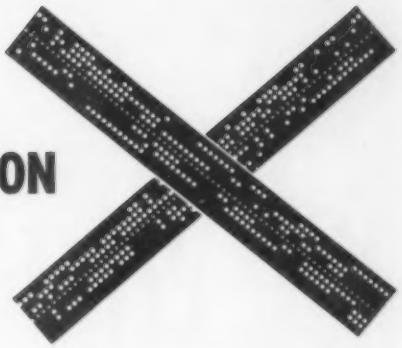
$76,000—**Melpar**, Falls Church, Va., for continued investigation of electronic neurons for flight control and other systems pertaining to satellite reliability and control.

$73,056—**Armour Research Foundation, Illinois Institute of Technology**, Chicago, for research on analytical investigation of combustion instability in solid-propellant rockets.

Space Technology Laboratories, Los Angeles, from AFSC, for a study of the effects of highly accelerated microscopic particles striking various surfaces. No amount disclosed.

Automation Industries, Inc., Manhattan Beach, Calif., for investigation of the use of infrared energy in evaluating critical aircraft and missile materials.

NOW
a new input for
MARKET PREDICTION



How often have you forecast your company's future on the basis of incomplete information? *Estimates* of the existing market, *arbitrary definitions* on its composition; *guesses* on your share, *someone else's thinking* on its trends.

Your ability to forecast is dependent upon the *accuracy* and *completeness* of the *facts* you start with. As in most jobs, you do the best work when you have the right tools—and a tool necessary for precise forecasting is full information on your current market. "You can't predict the future when you're standing in quicksand."

DEFENSE MARKET MEASURES is a quarterly statistical analysis that defines and measures today's missile, electronic, weapon and aircraft markets. DEFENSE MARKET MEASURES shows you for *each* of 180 system product categories: How many dollars are going into each of the system product markets. Which government agencies are making the awards. What kind of business it is. Which companies are receiving the business in specified system areas. Which companies are preferred by certain government agencies. How current bookings compare to last year's. Changes in the type of business. What growth systems are developing for the future.

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POSITION of your competition
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Every quarter, you receive a bound book of vital market statistics. This is *not* another market survey; it is a precise statistical picture of your market, correlated by data processing to insure accuracy and to present the information in a meaningful form for your use. Some of the categories that are measured: long distance radio navigation transmission systems, basic research in solid state physics, missile liquid rocket propulsion systems—plus 177 others.

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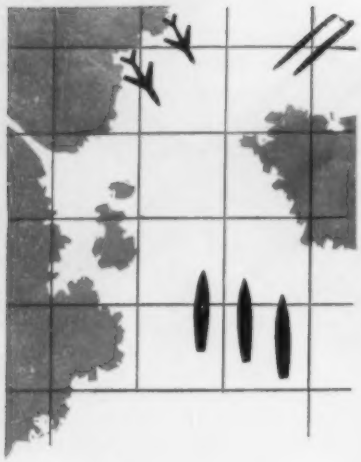

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fully controllable
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Ships, planes, and submarines to simulate combat maneuvers on battle terrain were required for a naval classroom training device. The problem was taken to Kollmorgen . . . and solved with a unique projector system that can produce up to 36 individual silhouettes of military warfare equipment—fully controllable at any speed, in any direction, and on any screen or wall. Depending upon design parameters, as many as 144 images or more could be provided.

The multi-image projector operates by utilizing a variable number of image projectors to cast preselected images on a screen. A separate projector system provides stationary grids or charts. Thus, images can be maneuvered on simulated battle environments by remote control.

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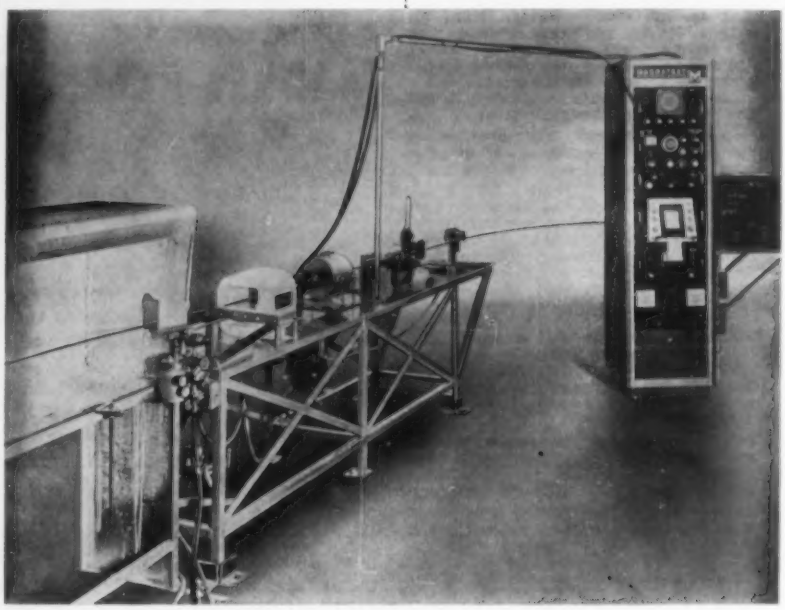
products and processes



Detector Finds Spring Flaws

Associated Spring Corp. is applying continuous high-speed electronic flaw inspection of ferromagnetic spring wire on a production basis. The system, using a specially adapted eddy-current detection technique, greatly improves the quality and reliability of high-performance springs.

Development of this production tool allows the elimination of any wire with harmful nicks, pits, and seams that may cause expensive spring failures in service. The test equipment uses a combination of electronic and mechanical systems. The electronic circuitry provides the signals for a tape readout which designates "off-specification" sections of the wire tested. Sections of wire failing to meet set standards are marked by a lacquer spray for subsequent discard.

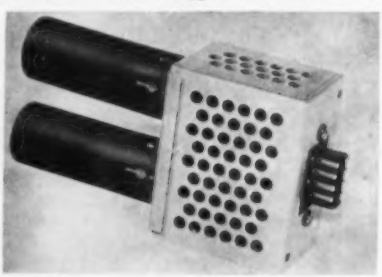
The tape becomes a permanent record that can serve to certify wire quality. An eddy current is induced in the wire by means of exciter coils. A pair of sensing coils detects any change in the normal eddy-current pattern of sound wire if the pattern is interrupted by flaws, such as pits, seams or scratches. The electronic equipment amplifies and filters these changes and then triggers the marking system. The equipment will initially be used primarily for the inspection of valve-spring quality wire. The unit also may be used to inspect other wire for springs requiring a great degree of reliability.

Circle No. 225 on Subscriber Service Card

Booster Follower

A new plug-in follower amplifier, Model K2-BJ to be used as a booster with militarized operational amplifiers has been announced by Philbrick Researches, Inc. A rugged militarized version of the earlier K2-B1, the new improved K2-BJ provides for the operational amplifiers an increased steady-state output of 20 ma at ±100 volts, gain about 0.8, output impedance about 250 ohm (before feedback).

Circle No. 226 on Subscriber Service Card



Rotary Generator

Pacific Scientific Instrument Laboratories is marketing a rotary acceleration generator designed for test qualification programs and production testing. The 20-in.-diameter spin table, designated model RA-ATC-500-1, tests dynamic characteristics of instruments and scientific objects from 3 to 500 g-pounds. Among these are accelerometers and

transducers, small flight packages and other instruments requiring high g qualification. A large number of ¼-in. tapped holes are arranged at increasing radii starting at 3 in. and going up to 9 in.; these are provided for securing test objects and fixtures. The rotary acceleration generator employs dual controls to provide an infinite variable platform speed within an operating range of from 10 to 2000 RPM.

Circle No. 227 on Subscriber Service Card

Linear Accelerometer

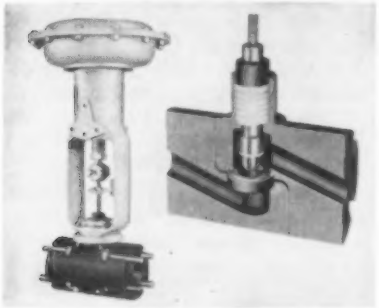
A miniature piezoelectric linear accelerometer that features high natural frequency characteristics, small size, and rugged construction has been introduced by Statham Instruments, Inc. The Statham Model AK 105 employs a sensitive, self-energizing piezoelectric element for reliable and accurate measurements of linear accelerations.

Designed to withstand aerospace environmental requirements, the Model AK 105 is encased in stainless steel and operates over a temperature range of −65°F to 250°F. Other characteristics of the accelerometer are: natural frequency, approximately 50 kc; sensitivity, nominal 17 peak millivolts per peak g at room temperature; weight, approximately 0.8 ounces.

Circle No. 228 on Subscriber Service Card

Graphite Control Valve

Designed especially for corrosive service, or where thermal shock is a factor, this single-seated control valve utilizes impervious graphite in the split-body construction. Impervious graphite is unaffected by all corrosives except a few highly oxidizing agents, it is immune to the effects of thermal shock and is non-contaminating to material in process. The valve is a product of Falls Industries, Inc.



Circle No. 229 on Subscriber Service Card

Cable Connector Kit

A designer's kit that provides design flexibility in the use of ribbon cable and includes the necessary items to fabricate special ribbon cable assemblies has been announced by Digital Sensors Inc. The connectors are the new Tape-Terms

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RCA Titan Project, Marysville, California, has a limited number of openings for experienced Missile Engineers willing to step *up* to RCA. Openings exist at all levels in these engineering areas:

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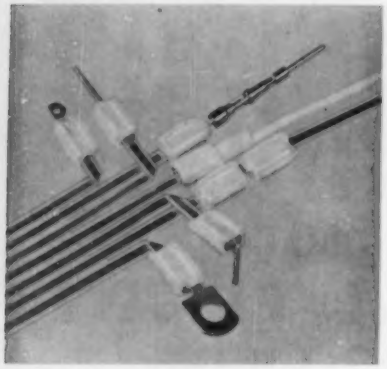

which are supplied in a variety of models for use in terminating or connecting ribbon cable to almost any type of electrical connection, including wire type connectors.

The Tape-Terms require no stripping of the conductors and are installed with a crimping tool provided in the kit. The kit also includes a five-foot-length of ten conductor ribbon cable, complete instructions on how to best apply ribbon cables and information on its characteristics.

Circle No. 230 on Subscriber Service Card

Versatile Cone Drill

Lower tool costs, fewer tool changes, and elimination of separate finishing steps in some drilling operations are made possible by a new cone drill developed by Scully-Jones and Co. A single drill produces a wide variety of hole diameters in metal, plastic, or any other relatively thin material. Tool change time and need for stocking a variety of drill sizes are eliminated. It drills any hole size from ¼" to 1¼". The cone drill eliminates circular hack sawing or knockout punching in sheet metal work. It has a 7/32-in.-diameter drill point, so no center drilling or punching is necessary.

Circle No. 231 on Subscriber Service Card

Radiation Test Set

A complete radiometric measuring system designed to test or evaluate optical systems, detectors or detector electronics, and to determine the effects of changes in configuration has been developed by Barnes Engineering Co. Also when used in conjunction with a known intensity radiation reference source, the test set can be used to obtain absolute values of the parameters for portions of radiometric systems. Values of monochromator resolution, optical filter transmission, optical system collecting power, detector responsivity, and in addition, relative values of many other parameters can be obtained.

Circle No. 232 on Subscriber Service Card

Analog Multiplier

Static accuracy of .15%, simplified circuit design, and reduced cost are features of the electronic multipliers, Model 160, from Applied Dynamics Inc. The multipliers are available on the firm's analog computers as separate components for expansion of other dc analog systems operating between ±100 volts as independent units or as individual boards.

Absolute value circuits permit reduction of the number of components, increasing reliability, and lowering cost of the multipliers, which can be used for multiplication, division, squaring, or extracting square roots. The solid-state units are temperature compensated, with bandwidth limited primarily by amplifier operation.

Circle No. 233 on Subscriber Service Card

Hall Devices

Two new Hall-Effect magnetic sensing devices—the Transverse Field and Axial Field "Hall-Paks"—have been produced by F. W. Bell, Inc. Both units are of non-inductive construction, making possible new and improved dc applications. They exhibit low noise output, improved low-level performance, and high Hall output combined with low zero-field output voltage to eliminate the need for external null voltage compensation in many applications. Both the axial and transverse "Hall-Paks" operate in the broad temperature range of —40°C to 100°C and are designed for continuous operation at 85°C.

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Circular Metal Seal

A circular metal seal designed to withstand any known space-age temperature or pressure extremes has been

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developed by research engineers of Lockheed-California Co., a division of Lockheed Aircraft Corp. E. B. Wiggins Oil Tool Co., which collaborated with Lockheed in product development, is manufacturing and marketing the BAR -X- seal under terms of a licensing agreement. Laboratory tests show the cruciform-profile seals remain effective at temperatures from −400 to 1500 °F, and at pressures from spatial vacuum to 600 lbs. per square inch.

Circle No. 235 on Subscriber Service Card

Ferrite Isolators

Sylvania Electric Products Inc. is marketing magnetically shielded ferrite isolators for operation from 1.0 gc to 11.0 gc. Designed for use in compact systems where component space is

severely limited, the isolators function in close contact with other magnetic materials with no degradation of performance or adverse effect on adjacent circuitry. They offer 10 to 1 isolation-to-insertion-loss ratios with maximum VSWR's of 1.3 to 1. Typical bandwidths are 1.36-2.56 gc, 4.2-6.0 gc, and 4.8-7.0 gc. All performance characteristics are maintained from −30 to 60°C. The units can be fitted with any standard coaxial connector.

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EBW Checkout Unit

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B_5H_9–F_2	360	460
N_2H_4–F_2	363	436
B_5H_9–O_2	327	421
B_5H_9–NF_3	326	412
B_5H_9–H_2O_2	316	405
B_5H_9–N_2O_4	306	391
B_5H_9–ClO_3F	306	390
RP–O_2	300	379
B_5H_9–ClF_3	290	368
N_2H_4–N_2O_4	291	354
CH_2–NO_2ClO_4	278	349

*Available upon letterhead request from:

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Headquarters: Callery, Pennsylvania. Telephone Evans City (Pa.) 3510
West Coast: 15537 Lanark Street, Van Nuys, California, Telephone STate 1-5761
Washington, D.C.: 709 DuPont Circle Building, Telephone ADams 4-4200
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—reviews—

MAN'S VIEW OF THE UNIVERSE, R. A. Lyttleton, Atlantic-Little, Brown, Boston, 108 pp., $3.95.

The author has used his hundred-odd-pages well by giving to the lay reader a lucid and seemingly unhurried description of our universe. This is a difficult thing to do—to discuss the earth in only nine pages, the planetary system in the same space, and the sun in only eight pages. Yet, in a style far more literary than telegraphic (although the latter might seem the style to use in a space so cramped), Lyttleton even manages to discuss some of the intricacies of recent astronomical investigations and to indicate some of the problems to be solved. This book is probably the easiest way for an adult to make his first step into astronomy.

METEOR SCIENCE AND ENGINEERING, D. W. R. McKinley, McGraw-Hill Book Co., New York, 309 pp., $12.50.

This is a book for the engineer who, either through curiosity or because of his job, wants to know something about the properties, behavior and effects of meteors and the means available for watching them.

The meteor expert looking for field and laboratories studies of meteorites will not find them here. Instead, he will find a good attempt at unifying the field of meteor science and engineering—first, by a survey of the visual and photographic techniques for watching meteors; next, by a technical but not overpowering discussion of radio techniques for keeping track of meteors; and finally, after going into astronomical aspects and some physical theory, by an easy-to-read study of the practical applications of the forward-scattering properties of meteors to commercial and military communications systems.

The author is well qualified to write the book, having published more than 40 scientific papers on radio observations of meteors in addition to other papers on radar design and electronic design. He is presently Associate Director of the Radio and Electrical Engineering division of Canada's National Research Council.

THE PHYSICAL PRINCIPLES OF ASTRONAUTICS, Arthur I. Berman, John Wiley and Sons, Inc., New York, 350 pp., $9.25.

The alternate title is "Fundamentals of dynamical astronomy and space flight," which is more descriptive because Astronautics, like Aeronautics, embraces the spectrum from vehicle design to modern physics.

What the author seems to be showing is the effects of the astronomical bodies and Newton's and Kepler's laws on space vehicles. He does this simply and well, so well that an engineer would find reading the book enjoyable as well as rewarding.

The text is written for late-undergraduate or early-graduate level, and for students whose calculus may be dusty but not tarnished. The author writes from fundamental principles and doesn't stray far from them. Most readers can add their own flourishes if they want to.

In Part I, semiquantitative aspects of the astronomy of the solar system are treated. Part II discusses those fundamental concepts of mechanics needed for an understanding of astronautics—mass, weight, potential energy, and Coriolis force. In Part III, the properties of orbits and transfer trajectories and the effect of perturbative forces are described.

In effect, the book is a starting point for the technical man going into astronautics. It is highly recommended.

TRANSISTOR CIRCUIT ANALYSIS, Maurice V. Joyce and Kenneth K. Clarke, Addison-Wesley Publishing Co., Reading, Mass., 461 pp., $10.75.

Here is a text for the serious student and worker in junction transistor circuitry. It presumes that the reader has a reasonable background in transient analysis techniques, in the use of pole-zero patterns in network analysis, and in logarithmic gain and phase plots. Given this background, the student will proceed easily through the basic methods of analysis given early in the book.

The authors emphasize that this is not a text in solid-state physics or transistor construction, nor is it just a compilation of a large number of transistor circuits. The transistor models employed in the book are restricted to a small number that are all easily interrelated.

Initially, simple low-frequency models are presented and are related to the underlying physical processes that occur in the devices. Then, after the reader has been made familiar with the simple models, the text introduces complications.

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AUGUST

American Society of Mechanical Engineers 1961 West Coast Conference of Applied Mechanics, University of Washington, Seattle, Aug. 28-30.

ASME and AIChE International Heat Transfer Conference, New Developments in Theory and Practice, University of Colorado, Boulder, Aug. 28-Sept. 1.

Third International Symposium on Rockets and Astronautics, Japanese Rocket Society, Tokyo, Aug. 28-Sept. 1.

Second Annual Bionics Symposium, sponsored by General Electric Co. and Cornell University, GE Advanced Electronics Center, Ithaca (N.Y.), Aug. 30-Sept. 1.

SEPTEMBER

Army Aviation Association of America Annual Meeting, Sheraton-Park Hotel, Washington, D.C., Sept. 3-5.

Farnborough Exhibition, England, Sept. 4-10.

8th Anglo-American Aeronautical Conference, Royal Aeronautical Society and Institute of the Aerospace Sciences, London, Sept. 4-14.

National Conference, Institute of Engineering Inspection and Society of Non-Destructive Examination, Oxford, England, Sept. 5-8.

Joint Nuclear Instrumentation Symposium, sponsored by IRE's professional groups on Nuclear Science and Instrumentation, AIEE, ISA, and others, North Carolina State College, Raleigh, Sept. 6-8.

National Symposium on Space Electronics and Telemetry, IRE, University of New Mexico, Albuquerque, Sept. 6-8.

National Conference, Association for Computing Machinery, Statler-Hilton Hotel, Los Angeles, Sept. 6-8.

1961 New Product Exhibit and Conference, Los Angeles Chamber of Commerce, Ambassador Hotel, Sept. 7-8.

1961 Fall Meeting of the Combustion Institute, Western States Section, University of California, Berkeley, Sept. 7-8.

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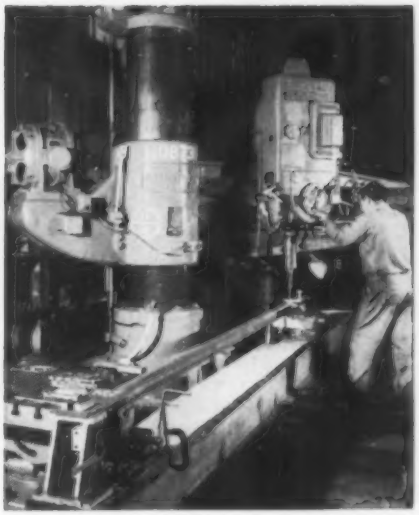

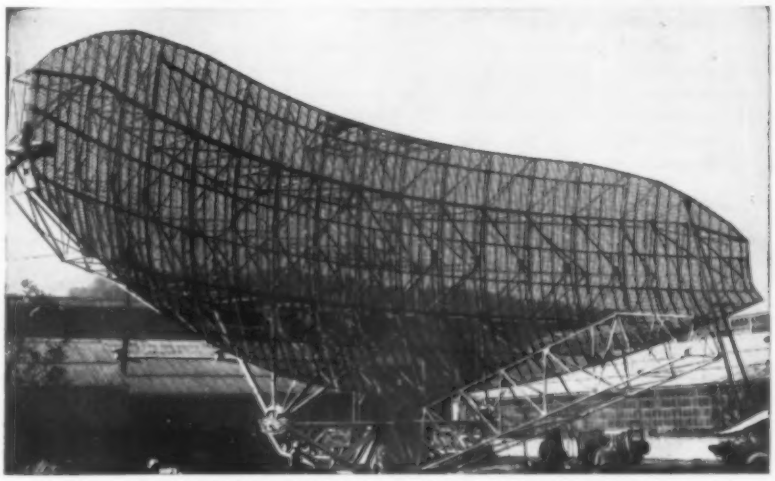

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Circle No. 19 on Subscriber Service Card

editorial . . .

Apollo Beset by Avarice

THE NASCENT *Apollo* program appears headed for real trouble unless some firm measures are taken.

"The way things are going, I will guarantee that we will be second on the moon," comments one of the missile/space industry's top executives.

It is easy to blame the National Aeronautics and Space Administration for the situation. More than three months have passed since President Kennedy outlined the ambitious project to put a man on the moon ahead of the Soviet Union.

Confusion would be a mild word to describe what has been going on at NASA since then. The agency was not geared for a space race as such. Not only was a review and overhaul of *Apollo* objectives necessary, but a new look at the unmanned lunar program was needed.

Industry members have been quick to point the finger at the space agency for the difficulties which are bogging down the program. Certainly, NASA is responsible for much of the indecision afflicting the project. Naming of a chief for the project, due shortly, may put an end to the wheel-spinning period if he takes firm control. The appointment is overdue.

But the industry itself must take much of the blame for the situation which has developed. And if the attitude of many major members of the industry doesn't change, the *Apollo* program may wind up as a second-rate effort when the national interest calls for the best we can put forth.

There is an unseemly scramble among companies seeking a piece of the lucrative project. Teams are being formed only to dissolve as one or another member deserts to a more promising camp. The almighty *Apollo* dollar is being pegged at a higher value than company integrity.

The temptation is strong to throw both integrity and judgment out the window in view of the rewards in sight. This is perhaps concomitant with a program of *Apollo's* potential. Company survival may in some cases be at stake. The firm which fails to get a piece of the *Apollo* program may face a bleak future, particularly as the missile programs begin to run down.

But this is a situation the industry must learn to live with. While a considerable number of dollars are to be spent in the U.S. space effort, they will be spent on fewer programs. The time gap between programs will become longer and the unsuccessful bidder will not find, as he has found in the past, another program coming close behind to keep workers and machines busy.

The dangers arising from NASA's indecisiveness and industry's shyster business tactics are secondary, however, to a greater hazard which is almost inherent in a program of *Apollo's* size.

IT IS QUITE APPARENT that rather than risk losing a piece of the program, some major companies are prepared to tell NASA what they think NASA wants to hear, regardless of their own views.

Unless top NASA officials and responsible industry executives move right now to head off this trend, it can do incalculable damage to the lunar effort. Traditionally, our national strength has been based on the flow of ideas from industry to government. To cut off that flow at this critical time in our existence, to cut it off for reasons of greed, will assuredly place us behind the Soviet Union. If it happens, we will deserve it.

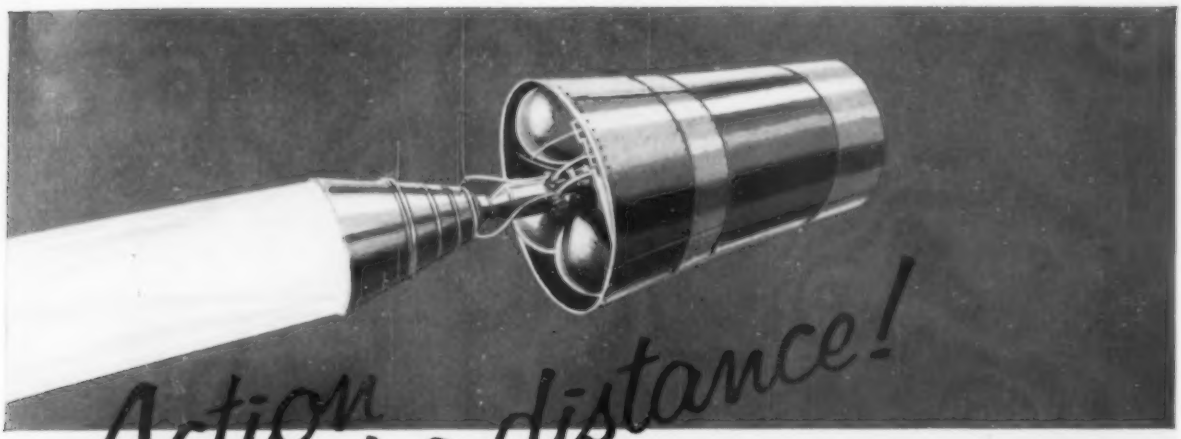
Yet we know of one major firm whose representatives admit privately that their *Apollo* proposal was not in their view the best approach. It was tailored to conform to NASA desires.

Integrity perhaps demanded less of a sacrifice in the days when a great variety of military aircraft were being procured. If you missed out on one contract, there was another competition coming up shortly. Yet we can remember when Ed Heinemann, then of Douglas-El Segundo, was willing to do battle with Navy brass concerning his ideas on lightweight aircraft. Some fine airplanes resulted.

More than ever, we need that kind of guts. The corporate risk admittedly is greater. But individual companies in the industry must put forward no less than what they believe is their best—and NASA must demonstrate its willingness to consider these ideas without prejudice.

If we then finish second, we will at least have run our best race. To do less, to let avarice overcome integrity, is, to put it in its bluntest terms, a betrayal of the nation.

William J. Coughlin



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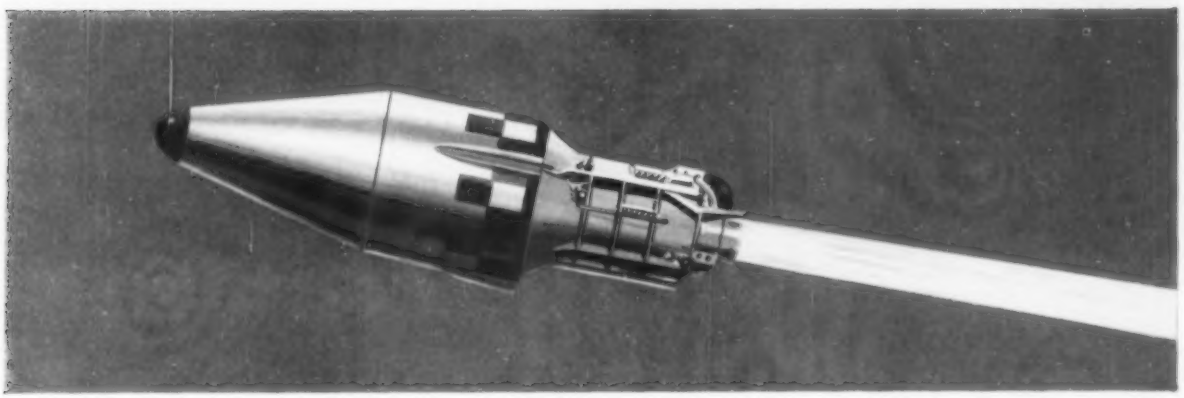

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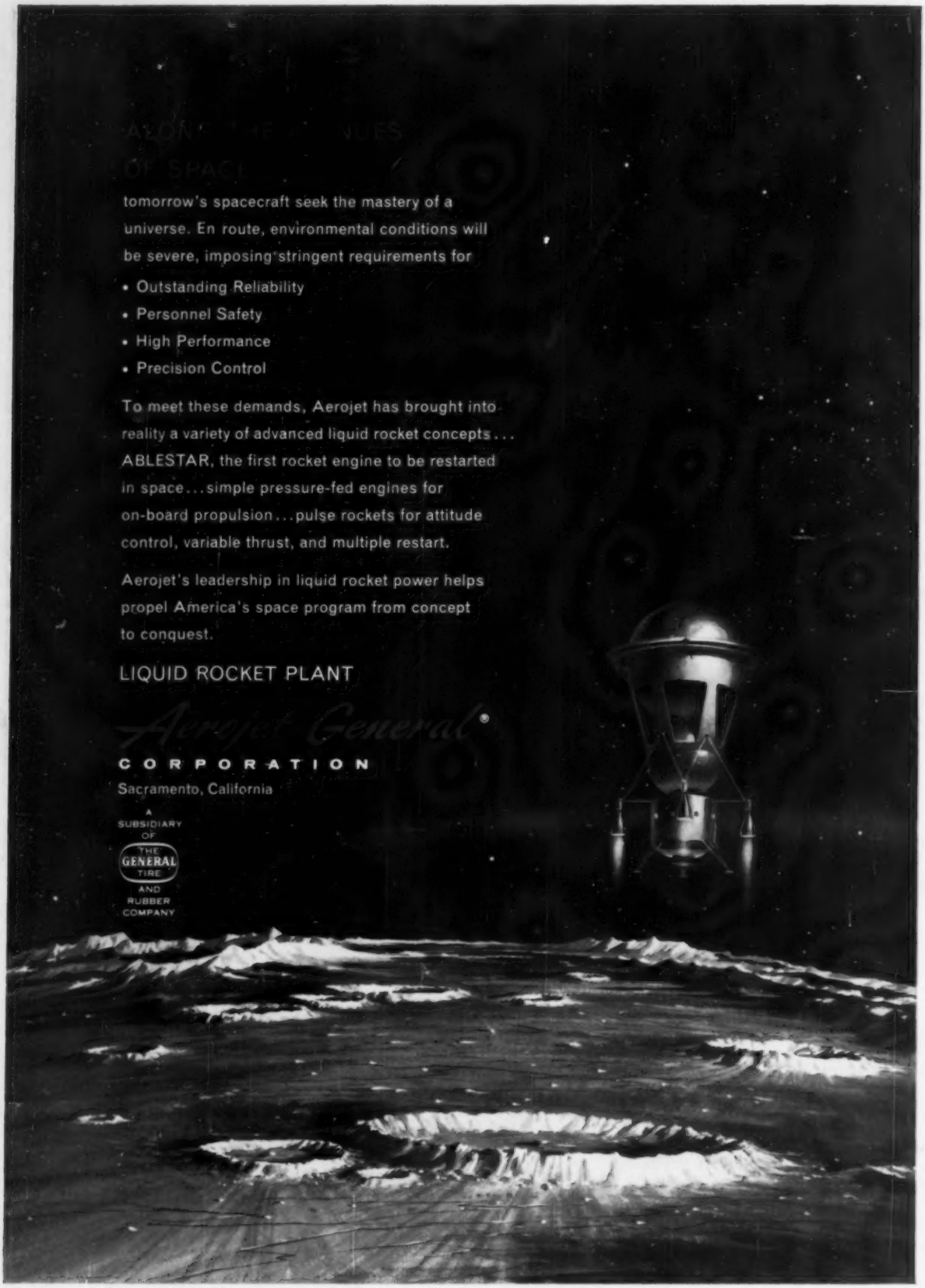
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